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PRESIDENT OF THE ROYAL COLLEGE OF SURGEONS

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AS A TESTIMONY OF ESTEEM

BY THE AUTHOR

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# INTRODUCTION.

To gain a proper knowledge of the use of the Stethoscope, it is requisite to begin this study in cases of healthy persons, and afterwards proceed to those which are diseased, until every sound which can be heard by means of this instrument has been obtained. Experiments on dead bodies ought also to be made. I have been occupied several years in obtaining a proper and complete knowledge of all the signs appertaining to the normal as well as to the abnormal condition of the organs of respiration and circulation. Many opportunities have been afforded me in Germany and France, and I flatter myself that I have not neglected them.

I take this opportunity of acknowledging my obligations to Prof. Puchelt, of the University of Heidelberg, for his valuable instructions; to MM. Louis, Andral, Chomel, and Piorry, of Paris, whose kind assistance in my studies I shall ever remember with the warmest feelings of gratitude.

In England there are the valuable works of Elliotson, Stokes, Williams, Hope, &c. from which I expect to obtain much information. Availing myself of these aids, I trust I shall succeed in presenting a book to the public, which may be particularly useful to the beginner, and not altogether useless to those who already possess some knowledge of the subject.

If there be any necessity for physical signs to guide us in our diagnosis of disease in general, it is particularly so in detecting the numerous and most difficult forms of the diseases of the chest. These are the most numerous and perplexing amongst the local diseases: in proof of this assertion, we need only to mention Catarrh, Phthisis, Pleuritis, &c. The danger of these diseases is only surpassed by that of the diseases of the brain. Dangerous, however, as the diseases of the organs of the chest may be, they present a series which is the most frequently curable amongst all the difficult internal diseases. The diseases of the organs of the chest are very numerous and varying. All of these present nearly the same or similar symptoms,

the principal of which are cough, dyspnœa, and expectoration.

In the first part of this work I shall endeavour to explain the different methods of exploration, which are known by the terms of *Percussion*, *Auscultation*, *Inspection of the thorax*, *Succussion*, *Mensuration*, *and Palpation.* In the second part I shall explain the frequent forms of the diseases of the lungs and heart in reference to the physical signs presented by them.

I have much pleasure in introducing in this place some valuable observations of my friend Sir Anthony Carlisle, illustrative of his views of the subject of Acoustics. These cannot fail to be instructive, in a scientific point of view, to the profession in general; to myself, they are further interesting as a testimony of his regard:

"*Langham Place, August* 12, 1837.

"My Dear Doctor Wolff,

"Your design to publish a copious account of the Stethoscope will be of great professional service; and as you have asked me to give you my thoughts upon Acoustics as appli-

cable to the use of that instrument, I now proceed to do so.

"The limited knowledge of the nature of sounds common to musicians does not explain many of the phenomena of sounds, nor is the mathematical theory of music sufficient to elucidate the uses of the structures belonging to the various organs of hearing. Apparently the organs of the senses in each species of creature are perfectly adapted for each other's uses; and hence we may infer that the human ear and the human voice are principally constructed to suit each other, although throughout the whole creation it is obvious that the intelligence communicated by sounds is not restricted to the sonorous productions or voices of the same species. Sounds are universal signals both by day and night, and ordained to abate certain obstacles of sight, also applicable to the evidences of moving bodies beyond the reach of contact; this sort of information, whether used for individual protection, or for predatory purposes, affording intelligence in the dark and beyond the lines of light.

"Sounds are regulated vibratory motions,

which to animal perceptions afford intelligence of the properties of the bodies from whence they originate, and generally their distance and degree of motion.

"The oscillatory or vibratory motions called sounds may either represent the properties of the substances from whence they issue, as in the falling of rocks, the rustling of trees, and the dashing of water, none of which are referable to musical notes; or the sounds may represent a compound motion, caused by the vibrations of the particles of a body, giving tone, and of determinate masses, giving a note, such as a bell, which yields a metallic tone, and has a defined note depending on the size and form of the particular bell. So likewise, in a harpsichord, the notes express the metallic *tone* of the wires; while, in a pianoforte, the note is transmitted from wood, and expresses a woody tone deprived of the wiry tone.

"Musical notes are definite numerical vibrations, and all concords depend on a coincidence of those vibrations, as in octaves, where the alternate vibrations coalesce in the proportions of two to one. These combinations of nume-

rical vibrations, termed harmonics, are more or less *convenient* to the human organ of hearing, as the intervals of union are regularly defined; for the *adjustable* membrana tympani is radiated, fibrous, and conical. Its surface is continually changing by muscular powers applied to rotate the malleus and to depress it inwards, affording the most extensive changes in the tension of the radiated series of fibres which pass between the manubrium of the malleus and the fixed periphery of the membrana tympani. A succession of musical notes, in the order of concords, produces similar agreeable sensations as when they occur simultaneously; hence the pleasurable effects of melody.

"It is interesting to philosophic minds to notice the general regularity which occurs during musical concerts in the concords; although the performers are placed at unequal distances from an individual hearer, which must bring the notes at different intervals according to the relative distances of the performers. These facts, together with those equally notorious, respecting the confusion of sounds in noisy assemblies, appear to be referable to the aerial transit of

sounds; but the subject may be further studied, and perhaps made applicable to certain kinds of deafness, for which new stethoscopes may be invented.

"The knowledge of these facts is essential in the applications of the stethoscope; and, in addition, it should be known that non-musical sounds do not depend on a regulated state of tension, as in a stringed musical instrument, or on the size of the bore and distances of the finger holes, as in a flute. Every organ of hearing is constructed to repeat sounds, and to represent them to the brain, or seat of perception; and as each differently formed animal has peculiar or special wants, the organs of the species are suited to such wants. It appears, from comparative anatomy, that the hearing of fishes is limited to a representation of a few tones, such as the percussions or motions of water, or its collision with stones; since fishes are destitute of voice, and they have no interest in aerialaff airs beyond visible impressions, for the notice of which their eyes are always *open*.

"The motions, called sounds, may prevail in many substances which are neither elastic nor

capable of oscillations, as in the instance of marble; but all substances are *conductors* of sounds; and the soft parts of the human body, even when consisting of heterogeneous textures and mixtures of moving fluids and solids, are good *conductors;* and hence we may learn how the *noises* transmitted to the wooden stethoscope may be conveyed to the organ of hearing. A remarkable and applicable fact occurs in the still time of night; for a person in bed may hear the scratching of a distant part of the pillow, of the sheets or personal clothing, without any intermediate aerial space, or the slightest tension of the clothing. These impressions resemble those of *touch*, only that they may denote the motions and properties of distant bodies, while the feeling of touch arises from positive contact.

"I think that the construction of the stethoscope may be practically improved, its modes of employment, and the evidence it supplies, rendered more certain, by introducing philosophical views derived from a wide range of phonics, of comparative anatomy, and of experimental observations. The human ear is

but a complicated microphone, and in the cases where the stethoscope is available, the only part of the organ of hearing engaged is that which most nearly resembles the sense of touch.

"ANTHONY CARLISLE."

---

*** I have thought it right, as a foreigner, to submit the revision of the following pages to the care of a gentleman of this country; for this, I am indebted to the kind services of Mr. HOBLYN.

# PART ONE.

## CHAPTER I.

### HISTORY AND EXPLANATION OF PERCUSSION.

*History.*—The employment of percussion was introduced by Auenbrugger of Vienna, in the year 1761. It was afterwards neglected for 47 years; after the lapse of which period, a translation of Auenbrugger's work by Corvisart drew the attention of the profession to this valuable practice. Läennec also cultivated this subject with great assiduity: it is owing to his exertions, together with those of Piorry, that it has become one of the most important guides in the diagnosis of the diseases of the chest and abdomen. It was Piorry who introduced the mediate percussion by means of the pleximeter.

*Explanation.*—If the wall of a hollow body be struck, it yields a sound, and opposes a resistance to the striking instrument. Sound and resistance are the guides which enable us to

detect the nature of the contents of the cavity. If, for instance, two hollow vessels be filled, the one with a fluid, the other with air, each of them will yield a different sound on percussion, and the resistance will be in the same ratio as the sound. The mode by which an impulse is communicated to the walls of a cavity, in order to enable us to judge of the material state of the bodies contained therein, is called *percussion.*

The senses of touch and hearing are more particularly engaged in this method of practice; hence the person only who examines can detect the result of the percussion.

*Preliminary directions for practising percussion.*—The patient should not rest on too soft a bed; no noise should be made in the vicinity. The position of the patient should depend upon the organs to be examined, and on the disease to be ascertained; the latter subject will be hereafter treated of. The stroke should be always made by moving the hand at the wrist-joint, and never with the arm stiff. The stroke should be applied strongly when the organ to be examined lies deeply or is little sonorous; gently, when the organs are super-

ficially situated and the integuments painful. It should be abrupt, i. e. the finger should be raised as quickly as it is applied, in order to estimate the sound accurately. The finger must rest longer on the part to be examined, when it is our object to ascertain the density of the texture. In practising percussion, the chest should be struck during an act of inspiration.

*Different methods of practising percussion.* —When the parts to be examined are struck directly by the finger, i. e. without the employment of any interposed substance, this mode of percussion is termed *immediate.* When the stroke is applied upon a solid body resting closely upon the parts under examination, the percussion is termed *mediate.* Piorry is the inventor of the latter method. The instrument he uses for this purpose is called a *Pleximeter ;* a piece of metal, a coin, or the fingers of the left hand, may however be used with equal advantage. The best pleximeters are made of ivory ; they are of a circular form, of two inches in diameter and one line in thickness, furnished with two projections, one on each side,

of four lines in height, the outside of which is concave.

*Immediate percussion.*—The parts to be examined, if lax, should be stretched with the thumb, index, and middle fingers of the left hand. The extremities of the four fingers of the right hand should then be placed in a straight line, and secured by means of the thumb; the stroke should be made perpendicularly, not using the pulpy parts of the finger-ends. If the sound be very sonorous, the parts very painful, or if the object be merely to confirm an opinion of the parts already entertained, the flat hand may be employed with the fingers close together and stretched. In the case of a very young child, or where a limited portion is to be percussed, the middle finger only may be used.

*Mediate percussion.*—This method may be practised either with the pleximeter (see percussion of the thorax), or with the fingers. In the latter case, the fingers of the left hand should be placed on the part under examination, and spread apart from each other. Particular

attention should be paid to the finger which is to receive the stroke; this should be pressed firmly upon the part. The stroke should be made with the fingers of the right hand in the way already mentioned under Immediate Percussion. The back of the finger should be percussed upon longitudinally.

*The two methods compared.*—In examining the thorax, the mediate percussion is preferable to the immediate. Among other advantages possessed by the mediate method, are the following:—it embraces the percussion of the ribs, as well as of the intercostal spaces; the mammæ, scapulæ, and musculi scaleni cannot be examined by immediate percussion; the integuments of the thorax may be infiltrated with serum, &c. and in such a case, if the pleximeter be only pressed properly upon the part, accurate results may be certainly obtained; it is, moreover, much easier to percuss in this than in a direct manner.

*Application of the pleximeter.*—The two projections of the pleximeter should be laid hold of with the thumb and index finger of the left hand; the instrument should be placed in

a direction parallel with the part to be examined. It should be placed on the naked integuments, if possible. When the parts are uneven, a piece of linen or cotton may be placed between the instrument and the parts. The instrument, having been previously warmed, should be applied in such a manner that it cannot stir or move, and pressed so firmly that no air can rush in. The use of the pleximeter ought to be preferred to that of the fingers; and beginners should never percuss with the fingers alone, remembering that a habit once acquired is with difficulty laid aside. If it is required to elicit much sound from an organ, the index and middle finger should be placed close together; the latter may however be bent a little, on account of its length. The thumb should be pressed towards the index finger, where the second phalanx of the latter unites with the third. The nails of the fingers used should be cut very short. The one half of the chest should be examined precisely in the same manner as the other.

## CHAPTER II.

THE THORAX, ITS SHAPE AND CONTENTS IN REFERENCE TO PERCUSSION IN THE NORMAL STATE, AND THE RESULTS OBTAINED.

THE dimensions of the cavity of the thorax vary considerably; it extends lower down behind than in front. Some of the contents are elastic, containing much air, as the lungs; others are muscular and contain fluid, as the heart. The same organ varies in density according to age, sex, &c.: the lungs of a child contain, under the same circumstances, more air than those of an adult; the thorax of the female is not extensible in the same degree as that of the male, &c.

*Percussion over the anterior walls, and over the lateral and posterior regions of the thorax in the healthy state.*—The thorax may be conveniently divided into the *anterior*, *the lateral*, *and the posterior parietes*. In percussing the *anterior* part with the plexiметer, the patient

should be seated, or he may be placed in the horizontal position; the shoulders should be relaxed, the trunk and head inclining forwards. The operator must occupy a convenient position. He should sit when the patient sits, and stand when the latter reclines. The pleximeter should be placed first on the upper part of the sternum, and struck at first gently, the force of the stroke being gradually increased. The tone here yielded is generally tympanitic; the resistance is like that of an elastic body. Descending to the middle of the sternum, about three inches above the xiphoid cartilage, we come to a spot which yields a somewhat feeble tone and more resistance. This part denotes the right cavity of the heart, and should be marked with accuracy; after which the operator may proceed to the sides of the anterior parts of the chest. The patient should always turn his head to the side opposite to that under examination. The triangular spot above the clavicle opposite the apices of the lungs generally yields a clear sound. In order to obtain a knowledge of the elasticity of the lungs, the patient should inspire as deeply as possible, and retain the air

in his lungs. The sound and resistance thus obtained should be compared with those obtained from the same part during expiration, as a means of acquiring proper information respecting the state of the lungs; because indurated lungs never yield more sound and resistance in inspiration than in expiration; whereas the difference is considerable in the healthy state of the lung. Percussion may now be practised over the clavicles, and from them downwards, the results on both sides being carefully compared together. The resonance is perfect on both sides until we arrive within a few inches below the papilla of the right side; on percussing this part forcibly, we meet with more resistance and more feebleness of sound, which gradually increase as we descend; at the lower part of the thorax the sound denotes the presence of the liver. On the left side of the thorax, in the normal state, the sound from the clavicle becomes weaker and the resistance stronger, as far as to the region of the papilla, but not so far down as on the right side. The resonance and elasticity of the left lung continue from the papilla often as far as to the last

false rib. The sound is weak on percussing strongly the inferior and anterior parts of the left side, when the stomach is full, the spleen capacious; or in ascites. But in tympanitis of the stomach and the bowels, the sound on the contrary is very clear, and the elasticity very great.

Previously to percussing the *posterior* parietes of the chest, the patient should be seated with his head inclined forwards, so that the back may assume a rounded shape, and draw the interior edges of the scapula as much as possible from the spine. Percussion should be practiced in the same direction from above downwards; first at the upper part of the ribs as near the spine as possible; then proceeding downwards until the specific tone and the elasticity of the lungs are no longer perceptible. We often find, on the right side, the thin flat part of the lung overlapping a considerable portion of the liver,—a fact important to be known. On the left side, at the most inferior part, a portion of the lung sometimes dips down behind the spleen.

When percussing that part of the chest which answers to the fossa supraspinosa, the

patient should sink the shoulders and draw them outwards. On examining the fossa infraspinosa, the patient should hold the arm upwards and outwards. Beneath the scapula, on the right side, a strong percussion will enable us to detect the presence of the liver, which occupies a large space and yields a very feeble tone. It is different on the left side, in which the spleen is situated lower down, is not so large, and affords more tone; this organ is also frequently displaced by the stomach and intestines.

In examining the *lateral* parts of the chest, the operator should stand before the side to be examined; the shoulder must be lifted upwards as much as possible, and drawn a little backwards; the arm must be turned away from the chest; the edges of the musculi pectorales majores and trapezius which border the pit of the axilla must be pushed aside with the fingers holding the pleximeter, and the instrument placed in the upper part of the fossa. The operator should now descend in the manner mentioned above, until he perceives on the right side the tone and resistance of the liver, and on the left those of the stomach, spleen,

and intestines. His attention should be directed to the parts where the organs are free, and where they are overlapped by a portion of the lungs.

## CHAPTER III.

### ANATOMICAL REMARKS ON THE HEART, SO FAR AS THE PHYSICAL SIGNS CAN BE EXPLAINED THEREBY.

The heart is situated in the left cavity of the chest, in the region corresponding to the lower part of the sternum and the cartilages of the last true ribs. The base of the heart is directed upwards, backwards, and to the right; the apex downwards, forwards, and to the left, answering to the fifth intercostal space. It is enclosed in a fibrous sac, which retains it in this position. It rests below on the diaphragm. The anterior edge of the right lung covers part of the right side of the pericardium and heart; the anterior edge of the left lung covers the left part of the heart almost entirely. That part of the heart which is generally not covered by the lung belongs particularly to the right side, and constitutes the upper part of the anterior surface

of the right ventricle. This uncovered spot presents a surface of from one and a half to two inches square. Sometimes the heart is entirely covered by the lungs. The heart is situated at some distance from the wall of the thorax, being separated from it by the whole thickness of the lungs. On the left side, the heart is nearer to the walls of the thorax; and at the anterior part of the left side it is only separated from it by a thin plate of the lung, and a small portion of the left ventricle. The right ventricle is, however, in immediate contact with it; at least, with the largest part of it. The heart is obliquely situated; and its greatest dimension is from the right to the left side, that from above to below being not so large. Enlargement of the heart takes place particularly at the expense of the lateral dimensions, and its longitudinal axis becomes more oblique. In consequence of the greater width and more oblique situation, the heart sinks lower down than in the normal state; its apex sometimes reaches as far as the sixth and seventh ribs, and its pulsations are sensible even in the epigastrium.

If the right ventricle be extended or dilated, it moves entirely to the right side. If the same abnormal condition take place in the right auricle, it extends upwards and to the right side, and touches the sternum more than commonly. If the left ventricle become hypertrophied, or dilated, it moves to the left, and approaches the left wall of the chest, the thin plate of the lung which covers it passing upwards at the same time. The internal surface of the pericardium is moistened by a serous fluid, which prevents any friction during the movements of the heart.

If the trachea be tied, an opening made into the pericardium, and as much water injected as possible, the pericardium will extend upwards. If the extension be carried to the greatest degree, the pericardium is removed but little, either on the right or left, from the heart; and in both these directions it is separated from the heart only by a layer of fluid of one or two lines in depth. At the upper part, however, where the water is situated two or three inches in depth above the heart, the pe-

ricardium will rise as high as the junction of the clavicle with the sternum.

The membrane lining the interior of the heart is called the *endocardium;* it takes the following course. It passes along the origin of the aorta, and envelops its semilunar valves; enters into the left ventricle, lining the whole of its interior surface; envelops the columnæ and the tendons attached to the valvulæ bicuspidales, and also the valvulæ bicuspidales themselves; it lines the interior of the left auricle and its appendix, and is lost in the interior membrane of the pulmonary artery. It takes a similar course in the right portion of the heart. The endocardium, in the normal state, is colourless, transparent, and absorbent; its thickness is about that of the arachnoid membrane of the brain; it is thinner in the right cavity of the heart than in the left, thinner in the ventricles than in the auricles, and thinnest at the mouths of the arteries and the auriculo-ventricular orifices. Around the valves, both the laminæ of the endocardium are so close together that they cannot be separated. The

cavities of both ventricles have not the same shape; that of the right being irregularly round, that of the left of a conical form. The cavity of the right ventricle is broader than that of the left; the left is longer than the right. According to Bouillaud, the circumference of the right ventricle, in a healthy person, is six inches; that of the left, four inches: the left is three inches in length; the right, two inches and three or four lines in length. The left ventricle, descending further down than the right, forms the apex of the heart. The direction of one ventricle is not parallel with that of the other. The axis of the right ventricle, when prolonged, forms an acute angle with that of the left. Laënnec says, "the heart, with the auricles included, is about the size of the fist of the individual." The walls of the left ventricle are more than double those of the right in thickness; their texture is firmer and compacter, by which means they are prevented from collapsing when opened. The right ventricle is a little wider than the left, and collapses when an incision is made into it. In a healthy and well-formed

person, the four cavities of the heart are almost of equal size. But the walls of the auricles being very thin, and those of the ventricles very thick, it follows that the auricles constitute, of themselves, a third part of the volume of the heart, and are equal to one half of that of the ventricles.

The following is a table of the weight and size of the heart in the normal condition, according to J. Bouillaud:—

1. Weight of the heart in an adult (from 24 to 60 years of age)..... 8 or 9 ounces.
2. Circumference of the heart at the basis of the ventricles..... 8 inch. 9 lines.
3. Length from the origin of the aorta to the apex..... 3 — 7 —
4. Breadth of the basis of the ventricles from one margin of the heart to the other.. 3 — 7 —
5. Thickness represented by a line that begins at the basis of the heart and proceeds perpendicularly from the anterior to the posterior surface, in the septum, which separates the two ventricles..... 1 — 11 —
6. Thickness of the walls of the left ventricle at the basis..... 6 —
7. Thickness of the walls of the right ventricle $1\frac{3}{3}$ —
8. Thickness of the septum auriculorum..... 11 —
9. Thickness of the wall of the left auricle... $1\frac{1}{2}$ —
10. Thickness of the wall of the right auricle . 1 —

*Circumference of the different Orifices.*

| | | | |
|---|---|---|---|
| *a.* | Orifice of the left auricle | 3 in. | $6\frac{1}{3}$ lines. |
| *b.* | ——— right ——— | 3 — | 10 — |
| *c.* | ——— aorta | 2 — | $5\frac{1}{2}$ — |
| *d.* | ——— pulmonary artery | 2 — | $7\frac{3}{4}$ — |

*Dimensions of the Valves.*

| | | |
|---|---|---|
| *a.* | Height of the tricuspid valve | 9 — |
| *b.* | ——— mitral | 8 — |
| | (this is thicker than the tricuspid valve.) | |
| *c.* | Height of the semilunar of the aorta | $5\frac{2}{3}$ — |
| *d.* | ——— art. pulm. | $5\frac{1}{2}$ — |

It should be observed that, in these measurements, the mean number has in every instance been taken. Sometimes the weight of the heart is diminished, while its dimensions are at the same time increased.

The best mode of dissecting a heart is to open the different cavities with a pair of scissors on the anterior surface, longitudinally.

*Percussion of the heart.*—A small portion of the anterior surface of the heart, which is in immediate contact with the sternum, is not covered by the lungs. This part, compared with the lungs, yields a solid, massy tone; it can easily be perceived on applying the plexímeter over the middle of the sternum, from

above downwards; it opposes much resistance. The space in which the sound is dull, and the resistance great, occupies about one and a half or two square inches. The place where the sound begins to be dull, on percussing the sternum from above to below, should be marked, the pleximeter conducted along the upper margin of the liver, from the right to the left, and percussion constantly practised, to a point where the tone is less clear and the resistance greater: the latter point should be marked accurately. Sometimes the tone of the right ventricle is perceived at the distance of an inch, to the right, from the right margin of the sternum, sometimes underneath the margin, and more inwards and towards the middle of the sternum. This spot should be marked, and the pleximeter conducted still more to the left; upon which, a duller tone and more resistance will soon be perceived, indicating the presence of the left ventricle. The more this is filled, the thicker its walls, and the nearer it is to the ribs, the feebler will be the tone, and the stronger the resistance. One or two inches more to the left, the resistance becomes less;

on gently percussing, more elasticity is afforded; but on strongly percussing, the massive tone and the resistance of the heart are perceived. Here the heart is covered by the lung—a firm, solid body underneath an elastic one. Still further to the left, the elasticity increases in proportion as the lung becomes thicker. To the right and downwards, where the heart and liver join, it is difficult to discriminate between these two organs by means of percussion. Whether the sound of the heart, surrounded by the lungs, is blended with that of the latter organ; and whether the sound of the liver, resting on the stomach or intestines, is blended with that of these latter organs, I leave to the decision of those whose sense of hearing is more acute than my own.

Tubercles, or condensation in that part of the lungs which surrounds the heart, modify the results of percussion of the heart; an hypertrophied thymus or a swelling underneath the sternum may be the cause of great mistakes. Percussion is useless when indurated lungs entirely surround the heart.

In a pathological point of view, percussion

of the heart can yield results only in reference to its volume, to the thickness or thinness of its walls, and the state of congestion of the cavities. We must not forget that, after venæsection, the heart diminishes considerably in volume, and that this diminution is in a direct proportion to the loss of blood. This is also a guide to enable us to ascertain, in hypertrophy of the heart with dilatation, whether the hypertrophy or the dilatation be predominant. A heart, enlarged by the increase of its muscular fibres, will collapse very little after venæsection; but if dilated or extended by a large quantity of blood, it will diminish in circumference after the bleeding.

Of the results of percussion in the *diseased* state of the organs of the chest, I shall treat when I come to speak of the diseases themselves.

## CHAPTER IV.

### ON AUSCULTATION.

*Explanation and History.*—The detection of sound by the application of the ear, in examining the organs of respiration and circulation, is called *auscultation.* The central organs of both these systems, so essential to the animal economy, being situated in the thorax, we shall speak only of this cavity.

The sounds in the chest are produced by the movement of the organs of respiration and circulation; and different diseased states produce certain modifications of these sounds. Hippocrates was accustomed to apply the ear to the chest, and he supposed he was enabled to hear a sound by which he could distinguish hydrothorax from an effusion of pus. This method had been neglected for more than two thousand years, when Laënnec drew the atten-

tion of the profession to the numerous results which he had obtained from this practice. In order to recognize the diseases of the organs of the chest in former times, attention was paid only to the interruptions of their functions; and these diseases, being so exceedingly numerous and perplexing, have very seldom been properly recognized. But, since the discovery of auscultation, we have been much more successful in our diagnosis. The instrument generally used for this purpose is called the *stethoscope;* it was invented by Laënnec. The instrument, however, as originally contrived by him, is, on account of several imperfections, seldom used; I rather recommend that of Louis. Laënnec attaches much importance to the material of which the stethoscope is made; and I am of opinion that the *lighter and more homogeneous* the substance is, the better it conveys the sound to the ear; the sounds in the chest being so feeble, that they cannot be conveyed far by means of the atmospheric air. The stethoscope is an excellent medium for the purpose. It resembles, in some degree, the external auditory passage. The length of the

stethoscope is a matter of little importance; hence, the conveyance of sound is not facilitated by putting one cylinder on the other, which is the direct effect of applying the ear to the stethoscope.

*Different methods.*—Auscultation, like percussion, may be immediate or mediate. It is called *immediate*, when performed by means of the naked ear applied to the surface of the body; *mediate*, when an instrument is interposed between the ear and the part to be examined.

*The two methods compared.*—The principal advantages of *mediate* auscultation are the following:—1, We can apply the instrument where it would be inconvenient to apply the ear; 2, we can examine parts with the stethoscope which we cannot reach with the ear, viz. the pit of the axilla; 3, different sounds are recognized by the stethoscope, which could not be detected without this instrument, as perfect pectoriloquy, and ægophony; 4, we can examine small limited spots by means of mediate auscultation, which is impossible by means of the immediate method: we cannot

apply the ear to the chest without resting a part of the head upon it; and experiments on deaf persons shew that the bones of the skull are conveyers of sound: hence we shall obtain the sound of a greater space by means of immediate than by that of mediate auscultation. It is to this latter advantage that the stethoscope appears to owe its principal value.

The *advantages* of *immediate* auscultation are not very numerous; but they are important, for the following reasons:—1, It is more convenient; 2, it can be done quickly; 3, it is not so unpleasant for the patient, who is apt to be alarmed, particularly on observing the very long instruments which are frequently employed. Both methods have, in fact, their advantages and disadvantages; both ought to be practised, and both ears ought to be used, since much depends upon the mode to which we accustom ourselves.

*Directions for practising auscultation.*—The auscultator should occupy a convenient position. The instrument must be applied carefully, and no space must be left through which the air could rush in. The thoracic extremity of the instru-

ment must be kept in exact apposition with the surface on which it rests, and the meatus auditorius should be preserved in accurate communication with the perforation of the instrument. The ear should be moved to suit the instrument, not the instrument to suit the ear.

In lean persons, some lint or cotton may be employed to fill up any unevenness. In such persons, too strong a pressure of the instrument must be avoided, in order to prevent the infliction of pain. The latter rule is also applicable to the stethoscope when employed without the stopper.

The ear must not be applied too heavily on the instrument; it must, however, be pressed closely to the chest, on practising immediate auscultation. The stethoscope is to be held like a pen, with the thumb and two first fingers, the points of which should touch the chest at the same time. The stethoscope may be applied either to the naked chest, or to the chest when covered; but woollen or silk garments should be avoided. The sides of the chest should be compared together, and both ears employed in the same manner.

When examining the *anterior* part of the chest, the patient should be placed on his back, in a recumbent position, or in a chair, gently reclining backwards, and his arms crossed on his back, his head inclining to the side opposite to that to be examined. When examining the *posterior* parts, the patient should be directed to lean forwards, and keep his arms forcibly crossed in front. On examining the *lateral* parts, the patient must lean to the opposite side, and elevate the fore-arm.

## CHAPTER V.

DESCRIPTION OF THE AIR-PASSAGES, SO FAR AS THE SIGNS OF AUSCULTATION CAN BE EXPLAINED THEREBY.

The organ which constitutes the lungs as a reservoir of air, is a thin, compact, mucous membrane, impermeable to air, and forming a sort of tube, which commences at the pharynx, and, as it descends, separates into branches, which become successively smaller and more numerous, and finally terminate, each, in a cul-de-sac. These terminal cavities form the air-cells which are observed on the surface of the lungs; their form is cylindrical.

In order that this membranous tube may always be ready for the reception and expulsion of air, it must constantly be in a state of ten-

sion, which is effected by cartilages; it must be capable of being prolonged and shortened, which is effected by its transverse muscular fibres; and it must also be able to dilate and contract its dimensions, which is effected partly through its ligamentous fibrous texture, and partly through the elastic white fibres which are attached longitudinally to the posterior part of the mucous membrane.

The cartilages which keep this membranous tube expanded, form, in its trunk and two first branches, rings, which are closed posteriorly by a membranous ligament, which at the same time surrounds these tubes. The cartilages cease to be circular as soon as the tubes ramify in the substance of the lungs. They then present irregular plates, which are so situated as to prevent compression of the smaller tubes. At the commencement of each ramification there is a cartilage, which presents more or less the form of a ring, and which keeps the mouth of the tube constantly open. As these tubes diminish in size, the above-mentioned plates become smaller and gradually lose their circular form, till at length they become small

semicircles; and these also disappear, as the tubes are reduced to half a line in diameter. In these parts they are no longer necessary; since the air never leaves the lungs to such a degree as entirely to evacuate the minute tubes.

## CHAPTER VI.

### THEORY OF AUSCULTATION AS REGARDS THE ORGANS OF RESPIRATION.

*Principles of auscultation as regards the organs of respiration.*—The lungs yield, during respiration, certain sounds in the interior of the chest, which are scarcely audible by the unassisted ear. Hence we make use of a solid body, which is a better conductor than the atmospheric air. These appear to be the *two principles* on which auscultation depends, as far as regards the organs of respiration.

*Explanation of the voice in reference to auscultation.*—The voice is produced during expiration. The air ascends through the trachea, on the top of which is situated the glottis, which is capable of dilatation and of contraction. The air, in passing through the glottis, produces a tone which is deeper or more acute

according to the width of that orifice; the narrower the glottis, the more acute is the tone; when the glottis is dilated, it produces a deep tone, which may be considered the primitive tone. The tone or voice thus created being expelled, becomes articulated by the pharynx, uvula, tongue, and other parts of the mouth. The syllables produced in this way are conveyed to the ear. The trachea is constantly filled with air, and is in direct connection with the mouth; hence the sound is conveyed downwards as readily as upwards. Hence it follows that, as solid bodies are better conductors than the atmospheric air, a tube applied to the trachea of a person speaking conveys the sound better than the atmospheric air: the voice may indeed be heard so plainly by this means, that it overpowers that which proceeds from the mouth. The voice of a hoarse person may, however, be heard very plainly; and if this sign can be detected low down, it indicates *pectoriloquy*. It should be observed that the tube must have a certain diameter to yield a tone. A tone can readily be procured from a thick, stout tube; but as the tube becomes

smaller, it is more difficult to perceive the tone: in tubes of which the diameter is merely capillary, no sound whatever will be produced. It will be readily conceived that the trachea admits the voice to be heard through it downwards: the voice becomes, however, more indistinct as the bronchi become smaller, until at last it cannot be heard at all. From these observations, it is evident that the voice cannot be heard in the chest, excepting in cases of lean persons, at the second and third dorsal vertebræ.

All that has been said in reference to the voice, is also applicable to the respiration.

*Inspiration in reference to auscultation.*—In inspiration, the air passes into the trachea, its branches, and the cells of the lungs, and produces, as in expiration, more or less noise over the upper part. This noise is also conveyed downwards, but decreases in intensity in proportion as the tubes become smaller, and their walls less firm. It is loudest over the larynx, the trachea, the parts of the chest opposite to the bifurcation of the trachea, and the second and third dorsal vertebræ: in the

last region it yields the *cavernous respiration.* It is weakest and scarcely audible in those parts of the lungs which consist of capillary bronchi and cells. If heard over these places while the voice is unheard, it may be *probably* owing to the following reasons:—The respiratory murmur depends principally upon inspiration; the voice is, however, produced during expiration, in which the air-cells do not take such an active part,—these small cavities being kept in a state of expansion by the air, which never leaves the lungs entirely. Another reason may be, that, in order to produce the tone of the voice, the air must impinge against a more or less solid body; hence, the cartilages of the trachea and bronchi are requisite for the mechanism of the voice. Where these cartilages terminate, the voice ceases.

From what has been said, it is evident that the organs of respiration ought to be examined, as regards auscultation, with three objects in view, viz.—*in reference to the signs produced by respiration; to those elicited by cough;* and *to those produced by the voice.* The two last being intimately connected, we shall treat of them both together.

## CHAPTER VII.

RESPIRATION IN THE NORMAL STATE OF THE THORAX, AND ITS CONTENTS, IN REFERENCE TO AUSCULTATION.

RESPIRATION generally proceeds quietly; but in sighing, deep inspirations and expirations, or after running very fast, and during sleep, it is heard through the mouth and nostrils. Any sound or noise in the lower part of the lungs is only audible to the auscultator.

If the ear, assisted or unassisted by the stethoscope, be applied upon any part of the thorax corresponding to the lungs, a kind of noise is heard, resembling, at every inspiration, that of a blowing tube or a pair of bellows, and conveying an idea of the expansion of many small cavities; this noise develops gradually. It is shorter and drier in expiration, and is called the *respiratory murmur*, being produced by the

free entrance and expulsion of the air in the bronchi and their ramifications. This phenomenon has been termed, with reference to its mechanism, the *murmur of the expansion of the lungs ;* and, from its seat, *respiration of the cells*, or vesicular respiration *(respiration vesiculaire).* Laënnec compares it to the noise produced by a person in a calm and sound sleep, yielding at intervals a deep respiration.

The respiratory murmur varies, in pathological states, according to its intensity, the place where it is heard, the age, sex, construction of the cavity of the thorax, the state of the integuments, the moral disposition, &c. The *places* in which the respiratory murmer is heard most distinctly and constantly, are the pit of the axilla, the space between the clavicle and the anterior edges of the trapezius muscle, the the space between the clavicle and papilla, and the space between the spine and the inner edge of the scapula. In all these places the lungs are situated contiguous to the walls of the chest. The absence of the respiratory murmur in these places is a negative sign of more or less im-

portance, in proportion as it is heard, or not, in other places.

*In children* under twelve years of age the respiratory murmur is much stronger in proportion than in adults, so that the most inexperienced can hear it. This depends partly upon the large quantity of blood passing within a certain time through the lungs of children, and which occasions more air to pass through them at the same time; and partly upon the magnitude of the lungs in children. After the *adult age*, the lungs increase in density, the air finds less space in the lungs, and the murmur diminishes in intensity. In *old age*, the density of the lungs is at the maximum state; and Magendie has shewn that in this period we find large cells, instead of the small vesicles of an earlier period; less space is afforded to the entrance of air, and the respiratory murmur becomes weaker. The murmur is not heard at all when, in old age, emphysema has been produced, through atrophy.

The more intense respiratory murmur in children is called *puerile respiration*. We some-

times, however, meet with adults, in a state of perfect health, in whom the respiration is puerile; and with children, in whom the respiration is like that of an adult. In *women*, the respiratory murmur generally approaches the puerile respiration, which may serve as a proof that the intensity of the murmur is in no proportion to the expansion of the thorax; for, in women, the thorax does not expand so much as in men. The quicker and shorter the respiration, the more distinctly we hear the respiratory murmur; hence the patient should be directed to respire shortly and quickly, but not deeply. In deep respirations the air cells develop gradually, whilst in short and quick respirations they develop at once and with more noise. Hence a succession of single coughs causes the noise to be more audible, the patient being obliged to inspire shortly and strongly immediately after the cough. In many patients the direction to cough is injurious; in others it is with difficulty checked. In such cases it is better to let the patient count one; two, three, &c.: after three or four have been counted, a short and deep inspiration always follows, which causes

the murmur to be audible, if that part of the lungs on which the ear rests be healthy.

The respiratory murmur is not so distinct in stout and fat persons as in the lean; it is also diminished by the contraction of the muscles, which sometimes obliterates the sound altogether. For these reasons the patient should be directed to sit down during auscultation, and assume the above-mentioned position, which causes the muscles to relax. In the erect position, these are in a certain degree of tension.

*The physical disposition* exercises also a great influence on this phenomenon. In many persons the sound is very loud; in others, very dull; in others, again, it is not perceptible under any circumstances.

The *principal character* of the murmur heard in healthy persons, in parts of the thorax corresponding with the lungs, consists in a peculiar sensation, as of the expansion of many small membranous cavities. A contrary sensation is produced when the murmur of respiration assumes a *blowing* sound, as if some one were blowing into the auscultator's ear through a tube. This is heard in the normal state, on

applying the ear or stethoscope to the larynx, trachea, or second and third dorsal vertebra; in these parts the air is heard rushing through capacious yielding cavities. This clear, blowing noise is normal when heard in the trachea, &c.; but when it proceeds from the lungs it denotes disease; for the respiratory murmur of the lungs must be stronger than the sound produced by the air passing through the bronchi: in the latter case the sound is called *tracheal* or *bronchial respiration*, according to the place in which it is heard.

## CHAPTER VIII.

### RESPIRATION IN THE ABNORMAL STATE OF THE THORAX AND OF ITS CONTENTS IN REFERENCE TO AUSCULTATION.

MALFORMATIONS of the thoracico-abdominal arch compress the organs contained therein, and modify their functions; the respiratory murmur in rhachitic persons, for instance, is remarkably weak, or it varies in intensity in different parts. The sounds produced in abnormal states of the thorax are modifications of the respiratory murmur, bronchial respiration, cavernous respiration, &c.

*Modifications of the respiratory murmur.*— The respiratory murmur, in diseased states, affords *two modifications;* the one depending on its intensity, the other upon its nature.

I. The *intensity* of the respiratory murmur may be diminished or increased. The diminution of intensity depends upon causes which have their seat either *in the walls of the chest*, *in the sacci pleuræ*, or in *the parenchyma of the*

*lungs*. The seat of œdema, pleurisy, pleurodynia, &c. is the *walls of the chest;* these diseases diminish the respiratory murmur. Œdema produces this effect by increasing the thickness of the walls: the respiratory murmur is feebly heard when the individual wears thick clothing. Pleurodynia is attended with the same result, the pain accompanying it causing contractions of the muscles of the chest. The same may be said of pleuritis costalis: in this disease the pain of the pleura extends to the wall of the chest,

The cause of the diminution may have its seat in the *sacci pleuræ*. The obstacles may here be of a solid, liquid, or aëriform nature; there may be false membranes, deposits of tuberculous matter on the pleura, effusion into the pleura, hydrothorax, pneumothorax, &c. The formation of false membranes in the interior of the pleura increases the thickness of the parts between the ear and the place where the respiratory murmur takes place: similar effects are produced by deposits of tuberculous matter: both of these diseases, consequently, diminish the intensity of the respiratory murmur. Em-

pyema and hydrothorax, also, sometimes diminish the intensity of the respiratory murmur; but this phenomenon only takes place when the effused fluid is considerable; if otherwise, the bronchial respiration is heard. In pneumothorax, the air situated between the wall of the chest and the lungs prevents the conveyance of the sound; it also prevents, by compressing the lungs, the entrance of air into the cells. If there be a communication between the bronchi and pleura in consequence of a perforation of the lungs, *metallic tinkling* takes place.

The cause of the diminished respiratory murmur may also have its seat in the *parenchyma of the lungs.* When anything prevents the entrance of air into a certain number of cells, the respiratory murmur in that part is diminished, or ceases altogether, in proportion as the entrance of air is prevented. On the other hand, the murmur is stronger in those parts in which the air circulates freely, in consequence of their performing their own and also the functions of the affected parts. In such a case, the respiration of an adult becomes *puerile*, the sound produced by the active parts being as

loud as that heard in a child. This sound is sometimes heard in one part of the lung, whilst the respiration in the adjoining parts is very weak, or quite imperceptible; sometimes it is heard over one entire side of the chest. In such a case, there is always an impediment either in the circulation or the respiration. The presence of tubercles is the most frequent cause of both these phenomena. But if the texture of the lung surrounding the tubercles be indurated, the murmur will be diminished.

At the commencement of the formation of tubercles in the lungs, the diminution of the respiratory murmur is first perceived under the clavicle of one side, or under both clavicles at the same time. Lobular pneumonia, deeply situated, gives rise to this phenomenon, and also to puerile respiration. When the lungs, after an attack of pneumonia, do not return to their former healthy condition, and when in a state of splenisation, the respiratory murmur continues to be weak.

Diseases of the heart frequently modify the function of respiration to a considerable degree.

In catarrhal affections of the lungs, the

intensity of the respiratory murmur is diminished, or ceases altogether. The latter effect takes place only when one or more of the large bronchi are obstructed with mucus, so that the entrance of the air into that part of the lung to which it supplies branches is prevented. In this case, this sign coincides with a complete resonance of the chest on percussion. In chronic bronchitis *(catarrh. sufocativ. senil.)*, this sudden extinction of the respiratory murmur, or its pathological substitutes, takes place in consequence of the obstruction of a large bronchus; it is often the forerunner of an attack of dyspnœa. After a threatening paroxysm of cough, the respiratory murmur recommences, or the patient dies from asphyxia.

There are two circumstances worthy of notice in reference to the decrease or the absence of the respiratory murmur:—first, whether the resonance of the chest, in those parts where these auscultatory signs are heard, is unaltered; and, secondly, whether the tone is dull on percussion. In the former case, the absence of the murmur may be periodical, or permanent. A temporary absence or diminution of the mur-

mur, when the resonance of the chest is perfect, generally indicates that species of catarrh of the lungs in which the bronchi are filled with fluid, and are consequently impermeable to the air. They are, however, relieved after a paroxysm of coughing, attended with expectoration. The permanent absence of the respiratory murmur, attended with a clear tone on percussion, characterizes emphysema of the lungs and pneumothorax. In the latter affection, percussion yields a tympanitic sound.

If, in any place of the chest, the respiratory murmur be weak, or absent, and the percussion dull, it is an infallible sign that the parenchyma of the lungs in that part is condensed and impermeable to air. This may be the result of an idiopathic disease of the lungs, a considerable effusion into the pleura, or a swelling in the chest. The respiratory murmur is very seldom diminished, or absent, above the clavicles, or over the second and third dorsal vertebræ.

II. The respiratory murmur may be modified with reference to its *nature*. The air may, for instance, not reach the cells or ve-

sicles, and proceed only as far as the bronchi: in this case, the sound perceived is called *bronchial respiration.* This phenomenon is heard when we apply the stethoscope to the larynx, trachea, or to the root of the lungs, in the healthy state. This sound varies in proportion to its intensity; but its *principal character* is always the blowing noise. It produces an impression upon the ear similar to that of air passing through a large, empty vessel. It is drier and stronger than the respiratory murmur; many of the small cells undergo no expansion. Andral notices three varieties of the bronchial respiration; many more might be described, if we had only names for them. In the *first variety*, the bronchial respiration differs from the vesicular respiration only in its intensity; it is a puerile respiration of a stronger kind. This frequently occurs in those parts of the thorax which yield a dull tone on percussion. The texture of the lung is, in these parts, condensed, as is corroborated by the results of percussion. Beginners ought to be very attentive, if they wish to detect this phenomenon accurately; for, upon

a superficial examination, it appears that the air passes freely in and out of the cells. But, on attentive examination, it will readily be found that the strong murmur is merely owing to the air not being able to pass further than the bronchi. In the *second variety*, the sound resembles that of a person blowing into the hollow hand. It can scarcely be mistaken for the vesicular respiration. In the *third variety*, the sound resembles that produced by blowing out the flame of a candle. These varieties correspond with certain modifications of the bronchi in reference to their size, strength, and connection. We shall subsequently explain the diseases indicated by each of these varieties of sound.

*Bronchial Respiration.* — Condensation of the parenchyma of the lungs is the original cause of the bronchial respiration; hence this sound is principally heard in the advanced stage of acute pneumonia, in chronic peripneumonia, in pleuritis, in phthisis, in dilatation of the bronchi, &c. The bronchi are largest at the root of the lung; hence, the bronchial

respiration is best heard at the second and third dorsal vertebræ. It is a sign of great importance when it occurs equally strong in other places. It may also be heard above the clavicles, but less distinctly. In the portion of the lungs situated in this part (the apex), the bronchi are most inclined to dilatation. It requires much attention to distinguish the bronchial from the vesicular respiration in children, in whom the latter is naturally very strong. If, in pleuritis, the effusion be considerable, the bronchial respiration is not heard. When there is a considerable exudation, this sign disappears, together with ægophony. If a considerable exudation be quickly re-absorbed, ægophony and bronchial respiration return; but if the affection have been of long duration, these results do not take place. In persons who have been affected with an exudation for six or eight weeks, the respiratory murmur has been known to be absent for four or five years, during which time the sound was more or less bronchial, or entirely suppressed (Chomel). In the second stage of pneumonia, the bronchial

respiration is an excellent pathognomonic sign. It may be heard even before percussion yields a dull tone.

*Cavernous Respiration.*—It requires considerable experience to distinguish this phenomenon from the bronchial respiration. Excavations of the lungs, in which one or more ramifications of the bronchi terminate, yield, during respiration, if not filled with fluid, a louder noise than that of the bronchial respiration. This is called cavernous respiration: it is a sign of little importance; for, in the first place, it is very difficult to distinguish between it and the bronchial respiration; secondly, we frequently meet with dilatation of the lungs (particularly at the point of this organ), which is recognized by the bronchial respiration. The bronchial respiration is sometimes heard in these places in persons of sound health; and it is well known that tubercular excavations are more commonly found at the apex of the lungs. Thirdly, the absence of this sign is a matter of indifference; as we generally find that the production of the secretion fills the excavation. Under such circumstances, no cavernous respi-

ration is heard; but a pathognomonic sign of phthisis is perceived, viz.—the *gurgling rattle* (gargouillement). The advice generally given to the patient to cough, in order to empty the excavations of their fluid, is, according to my experience, useless.

The cavernous respiration is sometimes heard to be very strong, conveying to the auscultator the idea of air being drawn from the ear during inspiration, and blown into it during expiration. Laënnec calls this sound the *blowing respiration* (respiration soufflante). This phenomenon sometimes indicates the proximity of an excavation, or a much-dilated bronchus, to the surface of the lungs. At all events, it denotes that the large bronchi at the root of the lungs are enclosed by condensed parenchyma of this organ. In other cases, the sensation caused by the blowing respiration is as if every vibration of the voice, cough, or respiration, agitates a sort of moveable veil interposed between the cavity and the ear. Laënnec called this the *veiled puff* (souffle voilé). It is supposed to depend upon the unequal density of the walls of the excavation in which it is

heard. Although I have heard this phenomenon frequently, I have had only one opportunity of convincing myself of this fact by a post-mortem examination. It should be well observed that cavernous respiration is very rare; it is very seldom heard clearly; and even if so, it is still uncertain whether it is the result of dilated bronchi enclosed by condensed parenchyma of the lungs, or of excavations. It may also be absent, the above-mentioned affections being still present. The bronchial and cavernous respirations are only gradations of the same phenomenon. They are analogous to those of the voice, in which we have the *bronchial*, the *cavernous*, and *bleating voice*. The principal phenomena upon which both depend, are the resonance of the respiration, or voice, in spaces larger than those of the cells of the lungs; and the better conveyance of the sound through the condensed, indurated texture of the lung, than through a healthy and elastic one.

## CHAPTER IX.

### AUSCULTATION OF SOME ADVENTITIOUS SOUNDS OF RESPIRATION.

*Sound of friction of ascent and descent* (bruit du frottement ascendent et descendent).—Reynaud has shewn that the lung, during respiration, falls and rises, and thus rubs against the walls of the chest.

In cases of pleuritis, in which the laminæ of the pleura are wrinkled, rough, uneven, and covered with indurations, a sound is heard over the affected part of the thorax, produced by the rising and falling of the lung. Reynaud compares this sound with that produced by placing a piece of cloth on the ear and rubbing it gently with the thumb. It is a dull sound, resembling that which might be produced under the stethoscope by the friction of the finger against a bone, and conveys the sensation as of a body

falling and rising, and at the same time rubbing somewhat harshly against another body.

Dr. Hebray relates a case, in which the part of the pleura covering the pericardium was rough and uneven over a limited spot. This produced the sound of friction of ascent and descent, in that part of the thorax which corresponded to the affected part of the pleura.

In order to hear this sound in pleuritis, the patient should lie with his face downward, and the stethoscope should be applied between the spine and the scapula. This sign is exceedingly valuable for the confirmation of the diagnosis: it is, however, very seldom present in this disease, several of the best observers having never heard it. Reynaud produced it in dead bodies by rubbing an elastic probe against the walls of the pleura. It exists also in interlobular emphysema; it is, however, supposed by some, that there must be a complication of pleurisy with this affection in order to its production.

*Metallic respiration, metallic voice, metallic tinkling* (tintement metallique).—Respiration, the different rattles, voice, and cough, present sometimes very peculiar characters, called *me-*

*tallic.* It appears as if all these phenomena were going forward in metallic vessels, sometimes as if such a vessel were struck with the top of a pin, or as if a grain of sand were dropped into it.

It is heard in the most striking manner when the patient coughs, and therefore, when it is doubtful, the patient should be directed to cough.

The metallic tinkling depends on the resonance of the air agitated by respiration, by coughing, or by the voice at the surface of a liquid, which, together with the air, forms the contents of a morbid excavation. It can exist therefore only in two cases; viz. that in which a serous or a purulent effusion co-exists in the pleura with pneumothorax; and that in which a large tuberculous cavity co-exists with very liquid pus. To produce this phenomenon in cases of emphysema or hydrothorax complicated with pneumothorax, the cavity of the pleura must communicate with a bronchial tube by means of a fistula; Dr. Williams, however, objects to this conclusion. From what has been said, it will appear that this sign is pathogno-

monic of this affection. Metallic tinkling may also be heard in cases of patients labouring under pneumothorax with liquid effusion, when they are placed in a sitting position, and some of the liquid which still adheres to the upper part of the cavity falls in drops into the liquid beneath. This sign is not a permanent one, and the patient must sometimes be examined repeatedly before it can be heard.

## CHAPTER X.

### RATTLES OR RÂLES.

The terms rattle, rhonchus, and râle, have been employed to express the respiratory murmur when blended with extraneous sounds; Laënnec employed the last of these terms. The following are the *conditions* in which the rattles are heard:—1, the air passes into the respiratory organs and meets with fluids in them; 2, the organs may be compressed, the structure of the mucous membrane altered, the diameter of the tubes diminished, and the passage of air consequently impeded. These two considerations may both be present at the same time, or they may exist separately.

Hence it appears that the rattles may be distinguished into two grand divisions:—these are, 1,—the *moist rattles*, depending on the first condition; and 2, the *dry rattles*, depending on the second. They have been also distinguished,

according to their seat, into the *cellular*, the *bronchial*, and the *cavernous* rattles, &c.

*Cellular rattle* (râle vesiculaire, Andral). —Cellular rattles are the moist and the dry. The former of these has been subdivided into two varieties; viz. the crepitant rattle, or the *râle crepitant* of Laënnec, and the subcrepitant rattle, or the *râle sub-crepitant* of the same writer.

The *moist crepitant* rattles are produced in all the cases in which the smallest cells of the lungs, or the minute bronchial ramifications terminating in them, are filled with a fluid. The crepitant rattle is considered as pathognomonic of the first stage of pneumonia, or that of engorgement (engouement), and represents an interrupted, sudden bursting of numerous little vesicles. It is drier than the subcrepitant rattle, and similar to the sound produced on compressing a healthy lung between the fingers, or on roasting butter near a gentle fire, or on throwing common salt on a hot iron. It is a matter of great importance in this case to ascertain whether the normal cellular respiration can be heard, besides the crepitant rattle. If the for-

mer is also heard, the engorgement has not yet arrived at any great extent; if it be entirely absent, the pneumonia is about to pass into the second stage, in which we hear neither the crepitant rattle nor the cellular respiration.

When the disease returns from the second to the first stage, the crepitant rattle appears again, but not the same as that just mentioned, being more humid, occurring in smaller vesicles, approaching to the mucous rattle, and passing into it, just as the mucous passes into the gurgling rattle. This is the *subcrepitant rattle* (râle crepitant de retour, Laënnec).

The subcrepitant rattle, when united with the rattles of the bronchi, denotes œdema of the lungs, which is very often complicated with diseases of the heart. It is in this case audible, particularly over the base of the lungs. I have often tried to hear it in hæmoptysis, but in vain.

Inflammation of the lungs mostly attack the lower part of this organ. Hence, when there is any suspicion of pneumonia, the ear should be applied to the posterior wall of the chest, near the angle of the scapula. The arm should be held upwards during the examination, and, if

the disease be in the first stage, if situated only in a few places, the crepitant rattle will generally be heard.

The *dry cellular rattle* may be sometimes heard, when the air, during inspiration, passes into dilated cells already containing much air, and bounded by hypertrophied, rigid, or atrophied walls, as occurs in emphysema of the lungs; this sound is termed the *dry crepitant rattle with large bubbles*, or crackling (râle crepitant sec à grosses bulles). In examining old persons affected with catarrh of long standing, one or more of the thin walls of the dilated cells of the lungs occasionally burst, and we then hear, besides the dry crepitant rattle, a sound much resembling the bursting of a seam; Laënnec called this the *crackling rattle* (craquement). Pneumonia seldom occurs in the same stage in the part affected; hence the difficulty of distinguishing the different rattles. Piorry produces the crepitant rattle in dead bodies in the following manner. He injects a frothy fluid into the trachea, and presses it deeply down into the lungs; he then places his ear over the lung while some one blows air into the trachea.

The crepitant rattle is heard in all the diseases of the lungs in which fluid is effused into the cells, whatever the nature of the fluid may be, provided it do not entirely prevent the entrance of air into the vesicles. The reason of this sign being more frequently met with in pneumonia than in other diseases, is, that in the former disease the above-mentioned condition more frequently takes place. The crepitant rattle is also heard in all states of asphyxia; in very old and weak persons who suffer constantly from chronic catarrh, and who have not the power to expectorate by coughing. Tarral and Reynaud have heard this sound occasionally in persons affected with exudation into the pleura; after a proper position had been assumed, a portion of the lungs was relieved. Piorry and Pailloux state that they have heard it in a dead body, in which the lungs were collapsed, were free from fluid, did not crepitate when pressed, and into the trachea of which air had been blown. The crepitant rattle passes through different gradations, changing into the rattles of the bronchi; viz. the mucous rattles. For this reason, we sometimes hear

the crepitant rattle in catarrh of the lungs, and the mucous rattle in pneumonia. It occurs but seldom in old age, more frequently in adults, and still more so in children, in whom the rattles ought to be carefully studied. It is heard most distinctly in the morning.

*Bronchial rattle* (râle bronchique).—The air in this case meets with impediments in the bronchi, either from the presence of fluids, or in consequence of a diminution of their calibre. The bronchial rattles are distinguished into the moist and the dry.

The *moist bronchial* rattle (râle bronchique humide, or the râle muqueux of Laënnec) resembles the rattle of the dying; it may also be produced by blowing bubbles with a pipe into soap and water; it is situated in the bronchial tubes. This rattle may occur in any disease of the lungs, accompanied with much expectoration. It is the principal symptom of a common catarrh, in which we find it combined with the dry rattles, particularly in the middle part of the lung; it occurs also in hæmoptysis. It is heard, in fact, in those diseases of the lungs in which the mucous membrane of the

bronchi is involved, although not affected primarily, as in phthisis, pneumonia, &c. It sometimes masks all the rest of the pathological phenomena of auscultation; hence it is, that auscultation is so often unattended with any results.

Of the *dry bronchial* rattle (râle bronchique sec) there are two varieties; viz. the *sibilous rhonchus* (râle sibilant sec of Laënnec), and the *sonorous rhonchus* (râle sonore sec of Laënnec). The dry bronchial rattle appears to depend upon the passage of the air through bronchi of diminished calibre The *causes* of this diminution may be a lax state of the mucous membrane, external pressure from condensation of the texture of the lungs, pleuritic exudations, &c.

The *sibilous* rhonchus has been compared to the chirping of birds, or to the sound occasioned by the sudden separation of two portions of smooth oiled stone. The *sonorous* rhonchus resembles somewhat the snoring (ronflement) of a person asleep, or the bass note of a violoncello put into vibration (son d'une corde de basse). In retarded inspiration, it resembles

the cooing of the turtle-dove (roncoulement de la tourterelle). All these modifications indicate alterations in the structure of the larger bronchi.

If the smaller branches, the last ramifications of the bronchi, are obstructed with tough mucus, or if any other alteration have taken place regarding their capacity, a *clear whistling rattle* (sifflement) is heard, of which there may be several varieties.

Nothing is of more frequent occurrence than these modifications and varieties of the dry and moist bronchial rattles. They are sometimes all present at the same time; sometimes they alternate one with another, in persons affected with chronic catarrh of the lungs.

*Cavernous rattle* (râle caverneux).—As the moist cellular rattle frequently passes through different gradations into the moist bronchial rattle, so this often changes into the cavernous rattle: in many cases it is difficult to distinguish the one from the other. The cavernous rattle is like the sound produced on gargling the mouth, or like that produced by blowing air through a tube into a thick solution of soap.

Laënnec calls it the *gurgling rattle* (gargouillement).

This phenomenon is produced, in inspiration, by the passage of the air into an excavation, in which there is a fluid of greater or less density, which it puts into motion, as in abscess or gangrene of the lung, and in the latter stage of tubercles.

The gurgling rattle, when distinctly heard at the upper part of the thorax near the clavicles, is the surest sign of tuberculous excavations. But it can by no means be heard in all cases of this kind; instead of it, the mucous rattle is sometimes heard. If, in such cases, the patient is directed to inspire deeply, or to cough, the mucous sometimes changes into the gurgling rattle. If the gurgling rattle which is heard at the upper part of the lungs continue downwards with decreasing power, if the side over which it is heard yield a dull tone, or if the respiration and voice be bronchial, we must not always conclude that there is a pleuritic exudation in consequence of the bursting of a tuberculous excavation at the upper part of the lungs. All of these symp-

toms are frequently the consequence of a tuberculous degeneration of a whole lung.

In concluding these remarks upon the auscultation of the lungs in reference to respiration, I would only observe that this practice is of much more importance than the auscultation of the voice and of the cough, in the diagnosis of the diseases of the chest.

## CHAPTER XI.

### AUSCULTATION OF THE VOICE.

*In the normal state.*—When we place the ear, with or without the stethoscope, on the larynx, or on the cervical region of a person of a loud voice, the voice traverses the stethoscope, and overpowers that proceeding from the mouth. The same phenomenon takes place over almost the whole of the lateral part of the neck. When we meet with this sign in a different situation from those above mentioned, it is a sign of disease, and is called after the affection it most frequently attends, *cavernous voice* (pectoriloquie).

When we apply the stethoscope to the substernal region of the trachea, or between the spine and scapula in the middle of the back, the voice of the person resounds very strongly, on account of the large bronchial branches

situated here; it is heard more distinctly than the voice proceeding from the mouth; but it does not traverse the stethoscope, at least not in adults. In children, the echo of the voice in the above-mentioned places cannot be distinguished from the cavernous voice. In the diseased state, this echo is found in different places, and the sign is then called *bronchial voice* (bronchophonie).

We do not observe the resonance of the voice in the ramifications of the bronchi in the lungs of a healthy person. The ear only experiences a slow thrilling sensation, similar to that perceived by the hand when resting on the chest of a person in the act of speaking. In persons with a very deep bass voice, it seldom resounds over the whole extent of the thorax.

*In the abnormal state.*—The auscultation of the voice in the diseased state depends upon two conditions: first, the lungs, which are bad conductors of sound in the normal state, become good conductors, in consequence of condensation and induration of their texture; and secondly, the tubes in which the sound is formed, the walls of which vibrate when speak-

ing, or against the walls of which the air strikes, increase in size, so as to present cavities. One of these conditions must necessarily be present when the voice is heard in any part of the thorax (with the exception of the parts above mentioned), whereas in the normal state we only observe a slight commotion by means of the ear. The two conditions are frequently found combined.

*Causes which produce condensation or induration of the parenchyma of the lungs.*— Pneumonia, particularly the second and third stages, effusion into the pleura, engorgement of the lungs, hæmoptysis, the presence of tubercles when very numerous, great extension of the bronchi (which can only take place at the expense of the texture of the lungs), swellings in the chest, &c.; all these conditions are characterized by the cavernous and bronchial voice. These two signs occasionally alternate with each other, exactly as occurs in the case of the sonorous and the sibilous rattles. Abnormally dilated bronchi, and particularly excavations in the lungs, produce, for the most part, the cavernous voice, or that modification

in which it appears as if the tone, before it reaches the ear, passed completely through the tube of the stethoscope; whilst, in pneumonia and pleuritic exudation, the resonance is strong without the tone passing entirely through the tube. Both these phenomena depend upon one principal character; viz. the *tubular blowing*, resembling the sensation produced by a tone in passing through a tube. The cavernous and bronchial tones are better heard with the stethoscope than by the unassisted ear. Cruveilhier showed first that an induration of the lungs in many cases produces the cavernous voice. Laënnec contradicted this statement. Others, and among them myself, are disposed to favour the opinion of Cruveilhier. Piorry says that, when he auscultated in the case of dead subjects, over the part corresponding to the large bronchi, whilst a person was speaking with a loud voice into the larynx of the dead body, or into a tube inserted into the trachea, he always heard the perfect cavernous voice, when the speaker's voice was distinctly uttered; he heard the bronchial voice when the speaker's voice was strong and sonorous; and the bleat-

ing voice when the speaker's was abrupt and acute. It appears from this that much depends upon the character of the voice and upon the manner in which the tones are articulated. If, however, we do not admit that the cavernous voice is heard in many other diseases of the lungs, besides tuberculous excavations, we ought still to remember, that its presence in this case depends on the combination of many conditions. To produce these conditions, it is necessary that the cavity be completely empty; that the parenchyma of the lungs, forming its walls, be indurated; that the cavity be connected with several large bronchi; and that it be not too far situated from the surface of the lung. The cavernous voice is scarcely ever heard in very large excavations, particularly if they involve only the minute bronchi. If an excavation be found to produce the cavernous voice, it disappears according as the cavity fills more or less frequently with fluid. If an excavation, superficially situated, has once opened into the pleura, or its contents have made their way into the cellular texture, the cavernous voice is no longer heard. For these

reasons I consider the cavernous voice to be no certain sign in the diagnosis of excavations of the lungs. Much more valuable, in this respect, are the gurgling rattle, the mucous rattle, and the bronchial voice.

We have already observed that the cavernous voice depends principally upon the stethoscope; under the naked ear it changes into a strong bronchial voice. In order to obtain it, the part of the stethoscope resting on the chest must be placed very closely upon it, whilst the ear must rest lightly on the upper part. This observation is applicable to ægophony.

*Bleating Voice* (egophonie).—In cases of a moderate effusion into the pleura, arising from inflammation of this membrane, and in cases of idiopathic hydrothorax, Laënnec discovered a certain echo of the voice, which sounded clearer, stronger, and more abrupt than that proceeding from the mouth, of which it appears to be only the echo. The rhythm and tone of the voice bearing, under these circumstances, some resemblance to the bleating of a goat, Laënnec called it *bleating voice* (egophonie). It is extremely difficult to distinguish

ægophony from the bronchial voice, particularly as the seat of both is generally the same; viz. that part of the thorax which corresponds to the root of the lungs, over the second and third dorsal vertebræ, between the inner edge of the scapula and the cervical vertebræ. This difficulty is further increased by the following causes: the sound of ægophony is not heard in all cases of pleuritis, nor that of bronchophony in all cases of inflammation of the lung; both these diseases are frequently complicated, in consequence of which ægophony and bronchophony frequently pass into and modify each other. The term 'bleating voice' is generic; and the description Laënnec gives of it is only one of the many hundred varieties comprehended under this denomination. Bouillaud says, "the bronchial and bleating voice *(egobronchophonie)* is the principal symptom of pleuropneumonia."

Ægophony is said to appear in the first hours of pleuritis; but it only becomes distinct in the second, third, or fourth day after the cellular respiration on the affected side has become weaker or entirely inaudible, and the tone on

percussion dull. It becomes weaker in proportion as the exudation diminishes; so that it is present only for two or three days during the continuance of acute pleuritis; whilst, in the chronic inflammation of the pleura, it can be perceived for months, in the most varying states of intensity, provided the effusion be not too great. If the exudation be very considerable, ægophony is not audible. This symptom reappears after a long absence; when, by absorption or by artificial or natural discharge, the quantity of the effused fluid is diminished. Laënnec attributes the sound of ægophony to the *resonance of the voice in the large bronchi, through the medium of a thin and tremulous layer of fluid, which causes the parenchyma of the lungs to be more compact from pressure, and consequently more capable of conducting sound.*

Bronchophony and ægophony occupy always a large space, whilst that occupied by the cavernous voice is very limited. Ægophony is mostly observed between the spine and the inner edges of the scapula, in the region of the lower angle of the scapula, and over the lateral

parts of the chest, over a space of from half an inch to two inches and a half beyond, and as much below, a line drawn from the middle of the scapula to the papilla. Ægophony is a rare and equivocal sign. I have examined a great number of persons affected with pleurisy, and have observed it in very few cases, although I paid particular attention to them on this account.

On the other hand, I have met with several well-marked cases of pneumonia, attended with crepitant rattle and bloody sputa, in which ægophony was plainly audible; hence, I am much inclined to adopt Reynaud's opinion, "that ægophony is only present in pleuro-pneumonia." In persons of a deep bass voice, we never hear ægophony. In women of an acute voice, it results from condensation of the parenchyma of the lungs.

## CHAPTER XII.

### AUSCULTATION OF THE COUGH.

In the normal condition of the lungs, we do not observe with the stethoscope any noise in the chest during cough; we only feel the impulse which is communicated by it to the walls of the thorax. In the diseased state of the organs of respiration, we sometimes obtain good auxiliary signs by placing the ear on the patient's chest whilst in the act of coughing.

In two cases, particularly, we obtain through the cough characteristic murmurs:—1, If an obstacle opposes the free entrance of air into the vesicles, whenever the patient coughs, the sensation afforded to the auscultator is that of air expelled with a certain sound, at no great distance from the ear, although not exactly into the ear; or as if the air reached his ear

through a tube. From the place in which this phenomenon is produced, it is called *bronchial cough* (toux bronchique, Andral ; toux tubaire, Laënnec). The bronchial cough accompanies generally the bronchial respiration. The former is generally heard most distinctly in well-marked cases of dilatation of the bronchi. 2, It is requisite to auscultate the chest of the patient during the cough, if an excavation of the lung be suspected. In this case, either the cough is accompanied by a gurgling rattle, which is more distinct than that in respiration, or the gurgling rattle is absent, and there is merely the tone which accompanies the cough : this presents a very remarkable modification ; for it appears as if this phenomenon is produced in a more or less capacious cavity, in which, at each inspiration and expiration, a certain quantity of air is put into motion. This modification of the cough is called *cavernous cough* (toux caverneuse). The size of the cavity, its distance from the surface of the lung, the manner in which the bronchi terminate in it, and the quantity and quality of the fluid contained

therein, modify this phenomenon as well as the cavernous voice.

The cough contributes in many cases to render the cellular respiration more audible, and also the cavernous voice plainer to the ear, in cases in which it is doubtful.

## CHAPTER XIII.

### AUSCULTATION OF THE HEART.

Previously to the discovery of Laënnec, the diagnosis of the diseases of the heart was not founded on sure principles, notwithstanding the exertions of Corvisart, who contributed much towards this object. Considering how numerous and complicated the diseases of the heart are, it will easily be seen that the vital symptoms are not sufficient to enable us to distinguish these diseases from each other: dyspnœa, cough, palpitation of the heart, irregularity of the circulation, &c. are not exclusively characteristic symptoms of the diseases of the heart. It is to the discovery of Laënnec, and to the subsequent exertions of Louis, Chomel, Piorry, Andral, Stokes, Elliotson, Williams, Forbes, Hope, Latham, Davies, Puchelt, Schoenlein, and others, that many happy

results have already been obtained; and more may be confidently expected, so soon as hypotheses shall make way for facts, in reference to the physiology of the heart.

*Action of the Heart.*—If the heart of a living mammiferous animal or bird be laid bare, it is seen that both the auricles and both ventricles contract and dilate alternately. The contraction of the auricles and the dilatation of the ventricles are synchronous, and vice versâ. These different actions are divided by pauses, so that one part of the heart is in repose whilst the other is in activity. The succession of these single actions, the pauses included, and the duration of each severally, are called the *rhythm of the heart's action.* In the normal state, two sounds, called the *sounds of the heart*, are heard in the impulse of the heart's action; this impulse may be felt, and sometimes seen. The sounds may be heard by placing the ear, with or without the stethoscope, upon the region of the heart. They can also be heard by the individual himself at night when lying on his left side. In the normal state, the impulse is only limited to a small

spot; but in the diseased state it may be very much diffused.

*Impulse or beat of the heart.*—When one extremity of the stethoscope is placed on the cartilages of the ribs or lower part of the sternum, and the ear is applied to the other, a sensation is communicated as if the head of the auscultator were elevated by each stroke of the heart; this is called the *impulse* of the heart. The apex of this organ beats against the walls of the chest, between the cartilages of the fifth and sixth ribs of the left side, owing to the contraction of the ventricles, notwithstanding the opinion of Corrigan, Burdoch, Stokes, Pigeaux, and others, "that the stroke against the wall (impulse) depends upon the dilatation of the ventricles." As the blood passes from the auricles into the ventricles, the latter exhibit a jerking motion; the apex of the heart is retracted towards the base, but inclines at the same time more forwards and upwards; since the longitudinal axis of the ventricles occupies almost a horizontal position during their systole, whilst the diastole of the ventricles is not attended with any locomotion.

In the diseased state of the heart, we sometimes feel an impulse during the diastole of the ventricles; but it is not so strong as that of the systole. The rising of the apex of the heart, during the systole of the ventricles, continues when the heart is removed from the chest, and placed upon the table; i. e. when the auricles are incapable of further extension, and the aorta and pulmonary arteries are separated from them: hence we may conclude, that this phenomenon is not produced by the dilatation of the auricles which takes place during the contraction of the ventricles, nor by the expansion of the arteries from the rush of the blood during this contraction, nor by the extension of the arch of the aorta owing to the impulse of the blood. The *principal cause of the impulse* of the apex of the heart against the wall of the chest is the rapid contraction of the ventricles, particularly of the left ventricle.

The systole is an active state of the ventricles and auricles. The diastole is considered a passive state, although it is executed with remarkable force. On applying the stetho-

scope to the præcordial region, we are enabled to estimate the intensity with which the four cavities contract. The impulse, communicated to the hand or ear, is directly proportionate to the thickness of the walls of the ventricles, and inversely proportionate to the extent over which we hear the sound of the heart. This impulse is inconsiderable in healthy and well-proportioned persons; in stout persons it is sometimes imperceptible; in persons in whom the walls of the ventricles are thick, the intensity is increased by fast walking, running, nervous excitement, fever, &c.; the intensity is much more increased by hypertrophy, in which case it is sometimes so strong that it raises the auscultator's head.

In nervous palpitation, the impulse is strong, short, and jerking. In hypertrophy with dilatation, not only the apex, but the entire ventricles, beat against the præcordial region. It appears in this case that the heart touches the walls of the chest; first with one point, then with its whole surface; and then shrinks suddenly back. The latter phenomenon is called by Hope the *back stroke;* it is a deci-

sive sign of hypertrophy, with dilatation of the heart. The ' back stroke' is synchronous with the second sound of the heart, answering to the diastole of the ventricles. In the normal state of the organ, or in dilatation alone, there is no back stroke. The systole of the auricles in the diseased state sometimes produces an impulse, which must not be mistaken for the back stroke. The systole of the ventricles, the first sound, the beat of the heart, and the pulse, are in the normal state synchronous; but in some cases, according to Hope, a pause is scarcely perceptible between the impulse of the heart and the pulsation of the radial artery; this is ascribed to the distance of the artery from the heart, since the pause has been observed to be greater in proportion as the artery has been more distant from the heart, and no pause whatever has been perceived when the arteries have been situated close to the heart. In a case in which the post-mortem examination proved that there was ossification of the tricuspid valve, I observed a considerable pause between the impulse of the heart and the pulsation of the artery. Passions and moral

affections have a great influence on the intensity and frequency of the impulse of the heart.

With respect to the *extent of the impulse* of the heart, it may be observed that, in healthy and well-constructed persons, it is generally felt between the cartilages of the fourth and seventh ribs of the left side, and perhaps sometimes at the lower part of the sternum. If the impulse be limited to the above-mentioned parts and become weaker in proportion as we recede from them, the state of the heart is normal. If the impulse be felt in other places, it arises either from diseased organs in the vicinity, or from affection of the heart itself, the impulse being proportionally greater as it is perceived at a distance from the heart.

The sounds of the heart are frequently perceived as far as the posterior part of the right side of the chest: this is very seldom the case with the impulse. There are various circumstances, unconnected with the heart itself, which may cause the impulse to be felt more extensively: in lean persons for instance, with a narrow chest, it is always felt more extensively; an indurated lung conveys the impulse better than

a healthy one; excavations of a zigzag form, being surrounded by indurated parenchyma, produce the same effect.

The impulse may vary from the ordinary standard in different individuals in the healthy state, and in the same individual in different states of disease; and this, 1, in its relation to the sounds; 2, in its degree or intensity; and 3, in its extent. Laënnec states that, "in excavations and pneumothorax, the sounds are conveyed better than the impulse; and that, in condensation of the lung and exudation into the pleura, the impulse is conveyed better than the sound." The assertion that the sounds are conveyed better in pneumothorax than in hepatization is without foundation. The extent over which the impulse is felt is generally proportionate to its strength. The reverse, however, may take place; the extent may be very great, while the intensity is diminished, as in many cases of dilatation; on the other hand, the extent may be very circumscribed and the impulse very strong, as in cases of concentrated hypertrophy of the left ventricle.

*Sounds of the heart.*—On applying the ear,

with or without the stethoscope, to the region of the heart, we distinctly hear two successive sounds, resembling the *tick-tack* of a watch, or the rattle of the valves of a pump ; these two sounds are followed by an interval of repose. The former of these sounds is duller and longer than the latter ; it is synchronous with the impulse, and nearly synchronous with the pulse, of the arteries,—an almost imperceptible pause taking place between the pulse of the distant arteries and this sound of the heart. It terminates, without an appreciable interval, in the second sound, which is clearer, louder, more acute, and shorter than the first, synchronous with the dilatation of the ventricles, and resembling the sound produced by the flapping of a bellows' valve, or the lapping of a dog. These two sounds succeed each other rapidly at every impulse, and, like the impulse, are followed by a pause, which is shorter or longer in proportion to the quicker or slower motions of the heart. (Both the sounds are audible in the fœtus from the fourth or fifth month of pregnancy). After the pause, the systole of the ventricles is audible again, and the second clear

sound follows in rapid succession. These sounds are more distinctly heard in lean persons than in those who are stout and corpulent; they are also much modified by the age, sex, and physical condition of the individual.

The sounds of the right and left sides of the heart, in the normal condition, take place at the same time and at the same spot, and merge into one single or into one double sound; we cannot, however, say whether the right or the left part is the more active in the healthy state. But in the diseased state of the heart this may sometimes be detected, and we can convince ourselves that each part of the heart yields two sounds, amounting to four in all, which, from circumstances of time and place, in the normal condition gradually become two. The sounds of the heart heard at the base of the sternum in healthy persons are generally clearer than those heard between the fifth and sixth ribs of the left side. Whether the sounds heard at the former place are those of the right ventricle, and those heard at the latter place those of the left, is not yet decided.

The first sound is heard best immediately

below and a little to the outside of the left papilla; the second sound is heard best immediately above and a little to the inside of the same papilla. From the distance, then, at which the sounds of the heart are audible, we are enabled to judge of their intensity and extent. In the normal state of the heart, they are most perceptible in the præcordial region; they may, however, be traced over a great part of the chest, with a gradual decrease in their intensity.

Diseases of the heart may cause a diminution or increase in the intensity of the sounds; and hence, the extent in which they are heard over the thorax may be diminished or increased; they may even become quite imperceptible. Circumstances, unconnected with the heart itself, frequently cause diminution or increase of the intensity of its sounds; and hence they may become more or less audible. For this purpose, certain modifications only of the parts surrounding the heart are requisite. The more condensed these parts are, the better they conduct the sound. Hepatized lungs conduct the sound better than those in a healthy

state. Every thing which has been observed in reference to the impulse of the heart is applicable to this part of the subject.

*How are these different sounds of the heart produced?* Many theories and many hypotheses have been proposed; but none of them explains this problem satisfactorily. The action of the heart includes four conditions, each of which appears to be capable of explaining its sounds. These conditions are the following:—1, the impulse of the heart against the wall of the chest; 2, the friction against the pericardium; 3, the passing of the blood through the orifices; and 4, the alternate motion of the opening and closing of the valves. Laënnec attributed the first sound to contraction of the ventricles; the second to that of the auricles; but this is not the case, since the contraction of the auricles precedes that of the ventricles. Corrigan, Stokes, Pigeaux, and Burdach ascribe the first sound to contraction of the auricles; the second, to that of the ventricles. "But the arterial pulse is as good as synchronous with the impulse, or follows the impulse too soon (a couple of thirds), the second sound following the first, or

the impulse only, in one fourth of the time between two impulses (twelve thirds). The second sound, therefore, cannot depend on contraction of the ventricles; nor the impulse, which is synchronous with the first sound, on dilatation of the ventricles and contraction of the auricles."* Williams considers the first sound the effect of the auricular and ventricular contractions, conceived to follow each other instantly; the second sound he supposes to proceed from the valves. Despine conceives that the first sound is the effect of contraction of the ventricles; the second, of their dilatation. Hope considers the first sound the effect of contraction of the ventricles, which precedes the contraction of the auricles; the second, as the effect of dilatation of the ventricles by the blood, driven in from the auricles and veins by the *vis a tergo*. Magendie and Müller attribute the first sound to contraction of the ventricles, and the stroke of the apex of the heart; the second sound, to the beat of the heart in dilatation against the chest. Hope's experi-

* Prof. Müller, British Annals of Medicine, July 14, 1837, p. 38.

ments, however, show that the sounds continue after the parts covering the heart are removed; and accordingly Magendie's and Müller's theory falls to the ground.

Rouanet attributes the sounds to the different valves. The first sound is produced by the sudden rising of the auriculo-ventricular valves during the systole of the ventricles; the second, by the impulse caused by the blood returning against the semilunar valves, during the reaction of the aorta and arteria pulmonalis against the pressure of the column of blood distending them. The first sound is heard, according to Rouanet, at the commencement of the contraction of the ventricles; and this has led to the opinion that the contraction itself is the cause. This sound is strong in proportion to the energy of the ventricles; it is duller than the first sound, the valves which produce it being broader; and the walls which receive it, thicker. The second sound is clearer, the valves being smaller and thinner, and the walls to which they are attached more sonorous. Experiments have convinced Rouanet that any membrane, altering suddenly from

a relaxed to an extended state, produces a tone. If such be the case, no membrane could be fitter for this purpose than the auriculo-ventricular valves; they are thin, oppose a resistance, and pass instantaneously from a relaxed to an extended state, &c. An experiment, made by Rouanet, appears to have convinced him that the second sound is produced by the reflux of the column of blood against the semilunar valves.

This theory appears to be very plausible, since it agrees tolerably well with the laws of physiology and pathology. With reference to the physiology, it is well known that the heart presents the same mechanism as a pump with two valves, one of which admits the passage of the water whilst the piston is raised, and closes when the piston goes down; whilst the other opens to the water, and closes when the piston is raised again; thus preventing the return of the water which has been raised. The sounds thus produced might well be compared with those of the heart. With reference to the pathology, it is beside the question to say that, of all the diseases of the heart, those of

the valves produce most commonly modifications of the sounds.

*Rhythm of the impulses of the heart in the normal condition.*—The duration of the several parts of the entire series of actions which constitute a beat is called *rhythm;* this is well explained by the following experiment of Hope: "The heart of an ass was laid bare, the circulation was artificially retarded, and air was blown into the trachea. The first motion of the heart is the systole of the auricles, the systole of the ventricles following immediately afterwards; so that these two actions appear to be continuous. The contraction of the ventricles presents a sudden shock, which is synchronous with the first sound and with the pulse. After a pause, the duration of which is equal to that which takes place between the first and second sounds of the heart, a sudden jerking dilatation follows, which appears to raise the ventricle more than the preceding systole, and which is synchronous with the second sound. After this, a pause follows, during which the ventricles remain filled. After this pause, the same series of motions recom-

mences, and is repeated from sixty to seventy-two times in a minute."

Laënnec described the duration of each beat as follows. The ventricular systole occupies about half the time of a whole beat; the ventricular diastole occupies one fourth, or at most one third; the interval of the ventricular repose occupies a quarter of a beat, or rather less; towards the termination of this, the auricular systole takes place. Hence it appears that, of twenty-four hours, the ventricles repose twelve hours, and the auricles eighteen. In this calculation, the diastole of the ventricles is considered to occupy a moment of repose. Hope differs from Laënnec in placing the repose of the auricles and that of the ventricles on a par. Laënnec did not take into consideration the pause which occurs between the systole and diastole of the ventricles. Circumstances which, in the normal state, modify the impulse and sounds, have the same influence on the rhythm.

## CHAPTER XIV.

### ACTION OF THE HEART IN THE ABNORMAL CONDITION.

*Irregularities in the rhythm.* — Idiopathic and sympathetic affections of the heart exercise a considerable influence on the number of its beats. Pericarditis, endocarditis, &c. produce great alterations in the impulse of the heart. In some fevers, the beats of the heart amount to 140 or 150 in a minute, although the disease is not situated in the heart. On the other hand, diseases of the brain and the use of digitalis very much reduce the impulses of the heart. In the year 1835 I saw, through the kindness of Mr. Gill, an eminent surgeon at Liverpool, a sailor who had fallen from the mast of a vessel and fractured his skull. The operation of trepanning, which was skilfully performed by Mr. Gill, led to the discovery of

an effusion of blood. The beats of the heart in this case were 38 in the minute. I have observed the actions of the heart to be reduced, by means of digitalis, to 42. These extreme accelerations and retardations are seldom without their influence on the rhythm. The duration of the pauses is diminished when the beat is accelerated, but increased when the latter is retarded.

The duration of any one action of the series constituting the beat, may, in proportion to the latter, be too short or too long: the systole, for instance, of the ventricle will be irregularly long when the arterial orifices are contracted; since the ventricles cannot propel the blood through them with their usual facility.

In reference to the *succession* of the impulses, there are several irregularities, which may be distinguished as follows:—

I. *Intermittent beat of the heart.* —After a certain number of beats, the action of the heart is suddenly arrested, and there is a pause of the duration of one beat. The number of such intermissions, within a certain time, may vary considerably. The intermittent impulse may be *regularly*, or *irregularly*, *intermittent*. In the

former case, the beats which occur between the intermissions are equal in number ; in the latter case it is otherwise. Laënnec also distinguishes between a *true* and an *apparent* intermission. In the former, the contraction of the ventricles is actually suspended; in the latter, it is only diminished to such a degree that the arterial pulse cannot be felt. Bouillaud notices a *false intermission.* When the left ventricle is not filled during the diastole with its appropriate quantity of blood, it contracts without expelling any blood, or without expelling a sufficient quantity; this is called an *empty contraction* (contraction à vide).

II. *Irregular impulse of the heart.*—The beats follow each other after pauses of unequal duration, and are sometimes of the same, sometimes of a different, intensity. The unequal pulse is generally intermittent at the same time; this state of things is called the *delirious pulse.* The irregularity of the beats may be of such a description that one irregularity differs from another, or the irregularities may follow each other in a regular succession. It is owing to this irregularity that one con-

traction of the ventricles is sometimes followed by two or three dilatations, and vice versâ. There are cases on record in which the contraction of the auricles has been heard in a single or double beat. It happens sometimes that a beat, generally consisting of two actions and two pauses, consists of three or four actions and as many pauses.

The diseases by which the rhythm of the heart is more particularly modified, are either of a vital, nervous nature, or they are organic diseases of an acute or chronic kind, as pericarditis, endocarditis, and particularly contraction of the orifices, from disease of the valves. The rhythm may also be disturbed by diseases of the abdomen. I knew a hypochondriac person, who had constantly an intermittent pulse. He became ill, and his pulse became regular; on post-mortem examination, the heart was found to be in a perfectly normal condition. There are many cases in which healthy persons have an irregular pulse, which becomes regular in illness, and in which it becomes again irregular on their convalescence.

*Anomalies in the impulse of the heart.*—The

impulse which can be felt, heard, and sometimes seen, is the measure of the power of the beats of the heart. The impulse may differ very much in power. There are cases in which it cannot be detected on the most careful examination; in other cases the beats are as forcible as those of a hammer, causing the thorax, the head, and the clothes of the individual to shake, In such cases the beats are generally more frequent and are called *palpitations*. The impulse is generally felt in the moment of the systole of the ventricles; it is a single beat; but sometimes another is felt during the diastole; I have had occasion to observe this frequently. There are cases on record in which one impulse of the systole is followed by two corresponding beats of the diastole. The systole of the auricles, which is, in the normal condition, unattended by an impulse, is sometimes unattended by this in the abnormal condition; Laënnec however, observes, that "the motion is deeper than that of the ventricles." Violent beats of the heart, if constant, frequently cause considerable elevation of the præcordial region.

Hypertrophy and atrophy of the heart

have the greatest influence on the permanent increase and decrease of the intensity of the impulse. But there are many other conditions which may diminish or increase the impulse; as nervous affections, passions, severe exercise, climbing, running, fever, inflammation, &c. There are cases in which the heart has ceased to beat several days before death, although its sounds were audible.

On the other hand, there are many cases of hypertrophy of the heart which are not attended by an increased impulse during life. Hence it appears that other conditions, besides the thickening of the walls of the heart, are requisite to produce an irregularly strong impulse. It is requisite that the fibres should contract with a certain degree of energy; but this is not always the case, in consequence of the thickness of the walls of the heart. There are cases of hypertrophy in which the impulse is only perceptible at intervals; this is frequently owing to improper diet, or the improper exhibition of irritating medicine.

The action of the heart is only perceptible between the cartilages of the first and seventh

ribs of the left side and at the lower part of the sternum. The left ventricle corresponds to the former, the right one to the latter place. But whether the motions of the left ventricle are only perceptible in the former place, and those of the right only in the latter, is yet undecided. Whether the beats in the above-mentioned places generally produce different results, when one side of the heart is affected, is also undecided, notwithstanding the authority of Laënnec for both these assertions.

*Extent of the impulse in the abnormal state.*—The sphere of the impulse of the heart is proportionate to its size. But the extent of the beat is also in a certain degree proportionate to the action of the heart. When the heart beats weakly and calmly, it has a less extensive impulse than when it beats more energetically. When the walls of the heart are condensed, while its cavities are undilated, the impulse scarcely extends beyond its common limits. But when dilatation is combined with hypertrophy, the impulse may sometimes be felt underneath the clavicles, and sometimes

at the posterior wall of the chest; the latter is, however, very seldom the case.

The impulse may be extended beyond its natural limits, in consequence of a change in the situation of the heart. Such a change of position may either be congenital or superinduced.

Alterations in the density of the parts surrounding the heart have great influence on the impulse and sounds of the heart. Adhesions of the lungs to the walls of the chest cause the sound to be more clearly conveyed. When the pericardium adheres to the heart, the impulse is more extensive. A similar effect is produced when the pericardium is distended with a fluid. Sometimes the impulse extends beyond the limits of the thorax, as when the liver is enlarged and approaches nearer to the heart. There is a phenomenon which generally accompanies the rasp and saw sounds, called, by Laënnec, *fremissement cataire*, or the cat's purr. Corvisart considers this as a principal sign of contraction of the orifice of the left side of the heart. This sign is detected by the

sense of touch; it is a thrill or purring tremor. When we place the hand on the præcordial region, we experience a kind of rustle, which is also communicated to the finger on examining the radial artery, although not so strongly. Laënnec compares it with the purring of a cat which is felt when the hand is applied to the back of the animal; or with the sensation communicated when a hard brush is passed over the flat hand covered with a glove. Bouillaud compares it to the sensation experienced when the hand rests upon the larynx of a person loudly speaking. This phenomenon has also been observed in the larger arteries, as the carotids, subclavian, brachial, crural, or the ascending and descending aorta. It is with difficulty felt in the smaller arteries. This purring is sometimes accompanied by a snoring sound. Respecting the cause of this phenomenon, Laënnec agrees with Corvisart; but he adds, that he has observed it in persons in whom, after death, no organic affection of the heart could be traced. Bouillaud says, it is felt in the region of the heart in all the

diseases which produce a sensation of rubbing in the heart, or between the heart and pericardium. This may be true, although it is not quite satisfactory. I have observed it frequently in cases in which the pericardium adhered to the heart after pericarditis. It is most frequent in diseases of the orifices and valves.

## CHAPTER XV.

### MODIFICATIONS OF THE NORMAL SOUNDS IN DISEASES OF THE HEART.

We shall speak, first, of the modifications of the normal sounds of the heart as regards their intensity and tone; and, secondly, of the adventitious sounds.

1. *Modifications of the normal sounds of the heart in reference to their intensity and tone.*— The sounds of the heart are clearer in proportion to their greater intensity; but weak sounds are always dull. The sounds are either full-toned, or they are dry; the latter is represented by the *parchment tone* (bruit de parchemin), in which it appears as if two sheets of parchment were applied to each other, &c. The sounds are, in general, weaker and duller in proportion as the walls of the chest are thicker and the cavities of the heart narrower, and vice versâ.

The *parchment tone* is said to be produced by hypertrophied thickening and stiffness of the left valves; the rough, hoarse, blowing tone, by a spongy, lax enlargement of the valves.

2. *Adventitious sounds of the heart.*—The character of the sounds may be changed; new sounds may either be superadded, or take the place of the natural sounds. The adventitious sounds of the heart and their modifications were named, by Laënnec, the *bellows' sound* (bruit de souffle), the *saw sound* (bruit de scie), the *rasp sound* (bruit de râpe), the *file sound* (bruit de lime à bois). The three last of these sounds are modifications of the first. The *musical whistling* (bruit de soufflet musical ou sibilant) was limited by Laënnec to the arteries. But it is a fact that, in the abnormal condition, the heart sometimes produces sounds resembling the chirping or singing of certain birds. This is not, like that of the arteries, uninterrupted, but it is intermittent, and in this respect is analogous to the beats of the heart. Laënnec says, " the bellows' sound is synchronous with the diastole of the ven-

tricles;" but I am convinced that it accompanies the systole as well.

The *musical whistling* generally accompanies one of the above-mentioned adventitious sounds. Bouillaud relates the case of a young woman in whom the saw sound was heard in the præcordial region, terminating in a whistling tone, which was synchronous with the pulse of the arteries, and which continued even when the respiration was suspended. On post-mortem examination, it was discovered that the left auriculo-ventricular orifice was contracted to a diameter of three lines.

The *bellows' sound* may mask either the first or the second sound of the heart, or both; and this either entirely or in part. In the latter case, it constitutes the after-stroke of the normal tone. In many cases, we cannot determine whether the after-sound accompanies the first or second sound of the heart, particularly when the contractions follow each other quickly. Laënnec says, "the bellows' sound is the result of a simple spasm, and of no organic affection of the heart or arteries." This, however, is not the case.

*The principal conditions which give rise to the bellows' sound are the following:*—1. The contraction of the orifices in consequence of organic alterations of the valves; it is, however, not permanent in this case. The absence of this phenomenon is of no great value; since we frequently find, after death, contraction of the orifices, and affections of the valves, whilst, during life, no adventitious sound was present. This observation is applicable to all diseases in which adventitious sounds are heard. 2. The bellows' sound is heard in cases in which the orifice of the aorta is contracted, without any alteration of the valves. This disposition generally coincides with hypertrophy of the left ventricle, accompanied with dilatation. 3. In cases in which the valves have been covered with adventitious growths without contraction of the corresponding orifices. 4. In considerable hypertrophy with dilatation, occurring particularly in the left ventricle, when the patient is excited. 5. It has been heard in cases in which coagulated blood formed in the heart before death. 6. In cases in which the semilunar valves of the aorta do not properly

close the mouth of the aorta. 7. In nervous affection of the heart, and particularly during a fit of palpitation. 8. After a considerable loss of blood. 9. In cases of plethora (?).

The modifications of the bellows' sound, viz. the rasp, the saw, and the file sounds, and the musical whistling, have been observed in contraction of the orifices of the heart, in consequence of induration of the valves. The bellows' sound, in the strict sense of the word, occurs more commonly in contraction of the orifices of the heart, when the induration of the valves is of a fibrous or a fibro-cartilaginous nature, than in bony or calcareous induration; more commonly when the valves are smooth and even, than when rough and uneven; more commonly in a moderate degree of contraction, than when this is considerable; more commonly when the actions of the heart are moderate, than when they are violent. But the rasp, saw, and file sounds take place under the opposite conditions.

The musical whistling is a higher degree of the bellows' sound, and appears almost under the same circumstances.

Adventitious sounds, audible in other diseases of the heart, with the exception of contraction of the orifices from affections of the valves, are generally limited to the bellows' sound, properly so called.

It is a decided fact, that organic stricture of the orifices of the heart is the most common cause of adventitious sounds. But Bouillaud's assertion, that the adventitious sounds are always produced by the same cause, viz. by the increased friction of the blood passing through the orifices, is unfounded ; and besides, it would not explain why this phenomenon is heard after hæmorrhage. Bouillaud, however, observes that in such a case it is produced by a convulsive energy, propelling a weak column of blood from the heart, through a cavity and an orifice, which are contracted in consequence of affection of the heart itself.

In the normal condition of the heart, we cannot distinguish the sounds belonging to the right, from those of the left side. But in the diseased state, we generally know by the sounds which side of the heart is affected. Robert Spittal has made some observations which

appear to him to prove that the affected side of the heat cannot be distinguished so certainly as Laënnec and others suppose, by means of the impulse and sounds; at least not in all cases. This observation of Spittal's must, however, be limited to hypertrophy or dilatation, severally, or combined. But as regards the affection of the valves, Laënnec's assertion is correct. Laënnec observes that the part, in hypertrophy, over which the sound and impulse are most indistinctly heard, but most plainly felt, is a certain sign. In dilatation of the left ventricle, he says, the only certain physical sign is the clear and loud sounding contraction of the heart between the cartilages of the fifth and seventh ribs; and in dilatation of the right ventricle, the strong sounding tone of the heart, heard at the lower part of the sternum and between the cartilages of the fifth and seventh ribs of the right side. In cases in which hypertrophy is combined with dilatation, we must first examine one side, then the other; we are thus enabled to ascertain whether one ventricle only, or both, are affected.

In cases of dilatation of the heart on one

side, and of hypertrophy on the other, Laënnec says, that the comparative examination of both sides of the heart leads to the certain discovery of any complication. This assertion has been adopted by almost all authorities, as Elliotson, Andral, Bertin, Hope, and others. It has, however, been questioned by Spittal, Bouillaud, and Corbin. The principal objection is, that, in cases in which one ventricle only has been attacked by hypertrophy, or dilatation, or by both of these, this ventricle is so surrounded by the healthy one that its sounds are entirely masked. On the other hand, we frequently find, in hypertrophy of a ventricle, particularly when united with dilatation, an alteration of its position, which must naturally alter the results of the sounds. These reasons cannot, however, set aside Laënnec's assertion, and they ought to be considered as *exceptions to the rule;* and a few exceptions generally confirm the rule. We must not forget to observe here, that Laënnec differs considerably, in a later edition of his work, from many of his former assertions, and that many of them he retracted. He qualified the assertion, that affections of the

right ventricle could be satisfactorily distinguished, by certain signs, from those of the left.

Hope observes, that "the left ventricle, which is more inclined to thickening and dilatation than the right, is sometimes increased to a size which the right one seldom or never attains; and when grown to a certain extent, it occupies not only the left præcordial regions, but extends far below the sternum, where its beats and sounds may be mistaken, as if proceeding from the right ventricle." Hope also observes, that when all the cavities of the heart are hypertrophied and dilated at the same time, the heart often increases to two, three, or even four times its size in the normal state. Its shape, therefore, instead of being longitudinal, becomes spherical; its apex scarcely perceptible; and as the diaphragm cannot sufficiently retract, to afford a proper space for the heart, it assumes a perfectly horizontal position, and extends so far into the left side of the chest, that the left lung is forced up to the fourth rib, and sometimes higher.

Robert Spittal relates the following case, in order to corroborate his opinion. "W. P. a

young man, 24 years of age, was affected with a noisy, irregular action of the heart, which was irregular in power as well as in frequency. The impulse was stronger than usual, and was most distinct between the fifth and sixth ribs, but more to the left than is generally the case. The pulse at the wrist was weak and intermittent. During the action of the heart no bellows' sound nor any other abnormal sound was observed." On post-mortem examination, the heart was found to be dilated and more obliquely situated than common; its apex reached to the sixth rib. The left ventricle presented less than its natural size and thickness; it was lax and soft, and collapsed on incision. The right ventricle was dilated, and its walls were considerably hypertrophied; the columnæ carneæ were thicker than usual. The walls of this cavity were firmer than in the healthy state, did not collapse on incision, and caused a hollow sound when touched with a scalpel. The termination of this ventricle formed the apex of the heart. The mitral valve was very much diseased, both parts of it adhered together extensively on both sides, by

means of a deposition of cartilage, which extended to some of the chordæ tendineæ. From this disease of the valve, the orifice between the left auricle and ventricle was so much contracted that it could only admit the point of the little finger. There was a little dilatation and thickening of the walls of the left auricle, and on the inside there were in several parts some thin earthy scales. In this case the right ventricle had, to a certain extent, changed its position with the left one. Its considerable dilatation appears to have pressed the heart more than commonly to the left side of the thorax. The signs afforded by auscultation in the present case, were decidedly such as indicated hypertrophy and dilatation of the left ventricle, but did not throw any light upon the state of the right ventricle. The post-mortem examination showed, however, the reverse; for the left ventricle was found to be lax and soft, and this softening probably produced the alteration in the direction of the heart; for it has been observed that the oblique direction of this organ inclines to the weaker side. This instance shows, satisfactorily, that there are ex-

ceptions to the rule respecting the diagnosis of diseases, as they occur in the right or in the left part of the heart, by means of auscultation.

Adventitious sounds are seldom heard in the above-mentioned forms of disease, unless they be complicated with affections of the valves; in these cases the normal sounds of the heart are to be considered in reference to their intensity and the modification of their sound.

If the sounds of the heart and the impulse are abnormal at that part of the thorax which corresponds to the left part of the heart, whilst at the base of the sternum they present different sounds, we cannot be sure that the left ventricle is diseased; for the right ventricles may be hypertrophied or dilated, or these affections may be so combined that the action of the right ventricle alone can be heard and felt. The normal or abnormal sounds, in this case, heard at the right side, belong either to the left ventricle, of which the situation is then reversed; or they may belong to the right, particularly when they are less clear, strong, or different from those of the left side. This is not to be wondered at; for, even in the normal condition

of the heart, the sound underneath the left papilla differs from that heard between the fifth and sixth, or the sixth and seventh ribs of the left side, and yet it is assumed that the sound here corresponds to the left ventricle. This is so true, that even the diagnosis of the diseases of the valves, which indicates more certainly whether the disease be situated in the right or in the left side, may be obscured by consecutive hypertrophy, or dilatation, or both together.

It is important, in diseases of the valves, to know whether the abnormal sound belongs to the auriculo-ventricular valves and orifices, or whether it belongs to the arterial orifices and valves; but scarcely any thing can be said upon this subject. According to Rouanet, the rhythm and the adventitious sounds heard in the præcordial region throw some light on this question. When the adventitious sound is heard during the contraction of the ventricles, i. e. accompanying or taking place of the first sound, it is most probable that the orifice of the aorta is affected. This probability is increased when the abnormal sound is heard strongest over the part of the thorax corresponding to

that orifice. But the bellows' sound produced by the reflux of the blood out of the ventricles into the auricles, in consequence of a diminution in size of the valvula mitralis and tricuspidalis, accompanies also the contraction of the ventricles. In this case, Rouanet observes that the adventitious sound is more distinctly heard in the region of the apex of the heart, than at the orifice of the aorta.

When the adventitious sound accompanies the diastole of the ventricles, or the second sound, one of the auriculo-ventricular orifices is probably affected, and the abnormal sound is produced by the passage of the blood through the affected orifice.

But the diastole of the ventricles is also accompanied by a bellows' sound, when the semilunar valve does not close the opening properly. But the strictest attention to the place where the abnormal sound is heard most loudly, enables us to discover, in some measure, according to Rouanet, the place where it is produced in the heart. Bouillaud also observes, that the bellows' sound, which accompanies the reflux of blood through an orifice not properly closed, is always single, either during the diastole of the

ventricles, when the semilunar valves are not properly closed, or during their systole, when the auriculo-ventricular valves are not properly adapted to the orifices. But the bellows' sound which accompanies organic strictures of the orifices is often a double sound.

The vital symptoms contribute much to the diagnosis: these are the pulsation of the jugular veins, the infiltration of different limbs, dyspnœa, throbbing of the head, a livid colour, &c.

## CHAPTER XVI.

### ABNORMAL SOUNDS ARISING FROM THE BEAT OF THE HEART AGAINST THE WALL OF THE CHEST.

In the normal state, the impulse of the heart against the wall of the chest does not cause a perceptible noise. But when the beat is unusually strong, we frequently hear, on applying the ear to the præcordial region, or even at a distant point from this, *a clear, silvery or metallic sound*, (tintement clair, argentin, métallique). All the causes which increase both the power and frequency of the beat of the heart may become conditions to produce this sound. It is more distinct in lean persons than in the corpulent; it is better heard with the naked ear than with the stethoscope. Laënnec called it the *metallic rattle* (cliquetis métallique). He observed it in the præcordial region in persons affected with nervous palpi-

tation, particularly when the heart beat powerfully and quickly. This sound may be produced by applying the flat hand closely to the ear whilst the back of it is slightly percussed; or on applying the ear to the thorax when this cavity is percussed.

This sound has hitherto always been observed during the systole; but there is no doubt that a strong diastole might produce it. The gliding of the heart in the pericardium during its actions, is, in the normal state, not accompanied by any sound. But when, in consequence of diseases of the pericardium, the smooth surface has become rough and uneven, some adventitious sounds become audible, which have been designated in the following manner by Bouillaud:—

1. *The rustling noise of the pericardium* (frolement pericardique). This resembles the sound produced by the crumpling of a piece of parchment or of a thick silken stuff. It has also some resemblance to the sound of friction of ascent and descent. It is double, like the motions of the heart; but stronger during the systole than the diastole of the ventricles.

2. *The sound of bursting or cracking, or the new-leather sound* (bruit de tiraillement et de craquement, bruit de cuir neuf).

2. *The sound of scraping* (bruit de râclement).—This appears to be produced by the scraping of a hard, bony substance against the pericardium.

Latham observed, in 1826, a bellows' sound in pericarditis, and he attributes it exclusively to the rheumatic form: it has, however, been more recently observed in all the species of pericarditis. Hope thinks that the bellows' sound in pericarditis is produced by the increased power of the beats of the heart. But this idea is unfounded; for there are cases in which the heart beats stronger than in pericarditis, and still no bellows' sound is perceptible: this sign is, moreover, sometimes present in cases in which the beat is very weak and powerless. Another and a better opinion of Hope's, is, that the bellows' sound in pericarditis is produced by the extension of the valves; in consequence of which, the orifice, the valve of which is swelled and thickened, is contracted. This extension of the valves is a consequence of the diffusion

of the inflammation from the pericardium to the endocardium ; and most probably the accompanying endocarditis is the cause of this phenomenon. It is not yet decided whether the formation of coagulated blood, which is always present in pericarditis, contributes to the production of this sound.

## CHAPTER XVII.

### AUSCULTATION OF THE ARTERIES.

*Sound of the arteries in the normal state.*—In auscultating the principal arteries of the human frame, as the aorta, carotids, subclavian, brachial, crural, external iliac, popliteal, &c. we hear, in the moment when the artery is shaken by the impulse communicated to it by the flow of blood during the systole of the ventricles, a *low murmur*, or a dull, weak noise, which varies with the size of the artery, the power and frequency of the pulse, the age, sex, and constitution of the individual, the thickness of the walls of the vessels, and the nature and quantity of the blood. Arteries, with soft and lax walls, and with diluted liquid blood, yield a clearer sound, approaching to the blowing sound; this may be increased by pressing the cylinder hard upon the artery; in this case,

it changes into a blowing noise, like that produced in contraction of the orifices of the heart, or in women at a certain period of pregnancy.

The sound of the arteries is single,—not double like that of the heart. It is synchronous with the first sound of the heart, excepting in the arteries which are remote from the heart. In the normal state, the sound and tremor of the arteries are not accompanied by a vibratory motion. The sound appears to be produced by the friction and the impulse of the blood in the arteries.

*Sounds of the arteries in the abnormal condition.*—Laënnec describes the abnormal sounds of the arteries under the terms, the *bellows' sound* and *the musical bellows' sound.*

Bouillaud distinguishes the four following sounds:—1. *The common or the intermittent blowing sound.* This is an increase of the normal sound, and it may be produced by a slight pressure on the artery. It is observed when swellings cause a pressure in the course of an artery; in aneurysms; in bony and cartilaginous disease of the arteries, with or without con-

traction of their calibre; in aneurysmal varix; in anæmia; in chlorotic, nervous, lean, and pale persons: it is produced by excitement. This sound may vary in strength and extent with the calibre of the artery, the power with which the arterial blood is put into motion, and with the organic affection which produces this phenomenon. It sometimes changes into a whistling sound. It is synchronous with the diastole of the artery, and with the systole of the ventricles. It is often accompanied by the cat's purr. 2 and 3. *The continuous blowing sound, or the blowing sound with a double current; and the devil's sound, or devil's snoring* (bruit de soufflet continu, ou à double courant; et bruit ou ronflement de diable; Bouillaud). These two sounds, first observed by Bouillaud, are only modifications of the same phenomenon. The 'bruit de diable' is only a higher degree of the continuous blowing sound. It is said to be like the blowing of the bellows used by blacksmiths. It consists of two sounds, the first of which is stronger than the second. Bouillaud has observed different varieties of this, one of which resembles the cooing of a dove; another, the

sound of the wind passing through a key-hole, or through a cleft in a wooden wall. In the latter case, the sound changes imperceptibly into the 'music of the arteries,' noticed below. The above-mentioned sounds are heard particularly in the carotids and subclavian arteries, on applying the stethoscope above the clavicle; they are sometimes heard in the crural arteries. The sounds, of course, cease when the artery is compressed above the place where the stethoscope is applied. 4. *The humming of the arteries, or the musical whistling* (chant des artères, ou sifflement modulé). Laënnec, who first observed this phenomenon, compared it to the sound produced by a jew's-harp. Bouillaud compares it to the buzzing of certain insects. The humming of the arteries is, in general, monotonous, plaintive, and sighing. The forte and a quicker tempo take place only during the systole of the ventricles; the piano takes place during the pause, which continues during two contractions. The forte sometimes occurs twice during the systole of the ventricles and arteries.

The purring sound is often united with the

single or musical whistling of the arteries. It is, in general, more extensive and less rough than that observed, in diseases of the valves, in the præcordial region. It is, according to Laënnec, independent of the sounds. One or the other of these sounds is generally heard in young and chlorotic women, affected with palpitation of the heart and oppressions. It is also frequently met with in pale, nervous, and delicate men; in hypochondriasis; and, generally, in young and irritable persons. In most of these cases, the serous and watery part of the blood is more abundant than the fibrous and colouring parts. This condition is a principal cause of these sounds; and hence they are audible in persons who are subject to hæmoptysis, or who, from copious bleedings and watery diet, are affected, temporarily, with anæmia and hydræmia.

When persons, in whom these sounds are audible, are in a state of repose, the arteries do not beat stronger than in persons in whom the arteries yield no audible sound. If such persons, however, are not affected with anæmia in a marked degree, the arterial pulsation is only

more extensive and diffused than in the normal state; it is as if the arteries were dilated, which is particularly perceptible in the upper clavicular region, and the lateral parts of the neck corresponding to the carotids; and this dilatation appears to be accompanied by a considerable degree of thinness and relaxation of the walls of the arteries. The beats of the heart also are more extensive, and their accompanying sounds clearer than in the normal state. No sound has ever been heard in the præcordial region which could be compared to the sound of the arteries in chlorotic persons, or with the continuous blowing sound. On the other hand, Laënnec observes that the intermittent bellows' sound of the heart is often audible in a high degree, without either of the above-mentioned sounds of the arteries being perceptible.

The modulated or musical whistling of the arteries is frequently audible over one half of the body only; it frequently disappears suddenly, and returns as quickly.

## CHAPTER XVIII.

### AUSCULTATIONS OF PREGNANCY.

*Auscultations of the heart in the fœtus.*—Lejumeau de Kergaradec first drew the attention of the profession to this subject; it has since been cultivated by Paul Dubois. On applying the ear to the abdomen of a woman, in about the middle period of pregnancy, two sounds are audible; one of these is double, the other single. The first sound, connected with the tick-tack of the fœtal heart, is the more intense in proportion to the age of the fœtus. It much resembles the sound of the heart in the cat or the rabbit.

The number of the beats of the heart in the fœtus is in the inverse ratio of its age. Bouillaud considers the maximum number to be 170 in a minute; Dubois supposes it to range from 140 to 150. The double sound is

sometimes audible over all the parts of the abdomen which correspond to the situation of the fœtus; but, in general, it is heard better on one side than on the other, and is generally most distinct in the vicinity of the umbilicus. It is always more distinct on the side opposite to that of the placental blowing sound; and, frequently, it is heard in this place only. In some cases, these sounds bear the same resemblance to the bellows' sound in certain diseases of the heart.

The double sound of the fœtal heart is a sign of pregnancy, and also a sign that the child is quickened; and sometimes we are able to ascertain, by means of auscultation of the fœtal heart, whether there is one child only, or more.

Another sound is heard in women, in the last four or five months of pregnancy. Kergaradec calls it the *placental sound* (souffle placentaire). This is a single sound, synchronous with the pulse of the mother; and, like the blowing sound, produced on compressing a large artery. It is principally heard over the lateral parts of the abdomen. This sound is

not always present in pregnancy; it is sometimes heard unconnected with pregnancy; hence it is a sign of no great importance. It is sometimes a whistling sound, and sometimes presents all the modifications of the common bellows' sound, the 'modulated blowing' excepted. This sound has also been observed in cases of tumor of the abdomen, compressing the vessels.

The seat of this sound is considered by Kergaradec to be the placenta; by Laënnec, the hypogastric, iliac, or internal iliac artery; by Bouillaud, those arteries which are pressed by the uterus and fœtus during pregnancy; by Dubois, the vessels of the walls of the uterus.

## CHAPTER XIX.

### INSPECTION OF THE CHEST.

*Preliminary remarks.*—The facial nerve, from its great influence on the muscles of the face, is particularly connected with the function of respiration. Every contraction, for instance, of the diaphragm and intercostal muscles is accompanied by a contraction of the muscles of the face; hence, many practitioners assert that they can detect pneumonia by the appearances presented by the point of the nose.

*Structure of the thorax.*—We are enabled to judge, by ocular inspection, of the structure of the chest, of the proportions of its different dimensions, of the arch of the ribs, of the size of the sternum, of the distance of the shoulders from each other, and of the capability of the lungs to expand. In many cases, the inspection of the chest is exceedingly useful, since

there are sometimes considerable malformations which are concealed by the apparel. The elevated state of the chest, caused by hypertrophy with dilatation, and which might easily be concealed by the patient's linen alone, will thus be readily detected.

We are also enabled to ascertain, by means of inspection, whether one half of the thorax is larger than the other. The phthisical habit is thus detected. I do not mean to assert that all persons affected with phthisis exhibit the peculiar signs of this affection, for they are to be observed only in the smaller number. Persons thus affected are generally most liable to hæmoptysis. In persons affected with cyrtosis, the auscultation of the heart is sometimes practised more successfully over the spine than over the præcordial region.

*Respiration in the normal condition.*—Respiration in man and in all the mammalia is produced by dilatation and contraction of the thorax. The diaphragm is the principal agent in dilatation; it is arched upwards when relaxed, but becomes horizontal in contraction; as its arch descends, it extends the chest, by

which means the contents of the abdomen are pressed downwards. This pressure causes the apparent swelling of the abdomen in inspiration. When the diaphragm relaxes, the intestines recede, and the abdomen again becomes flat. The action of the diaphragm causes the enlargement of the cavity of the thorax, particularly from above to below. The extension from before backwards, and that of the lateral parts of the thorax, are produced by the musculi scaleni, the intercostalis, the levator costarum, serratus posticus superior, cucullaris and pectoralis, and also by the ribs and sternum.

*Respiration in the abnormal condition.*— The principal part in respiration is performed by the diaphragm. The thorax may expand very extensively without any proportional increase of the sounds of respiration, &c.

The *abdominal respiration*, or that in which the diaphragm acts exclusively, is a sign of less importance in diseases of the chest than the thoracic respiration in diseases of the abdomen. The abdominal respiration is said to be present in intensive and extensive inflam-

mations of the lungs and pleura; in chronic pleurisy with effusion, when the lungs adhere to the pleura on both sides, and in their whole extent; and in all cases in which the lungs do not admit the air. But the abdominal respiration may also be present, without any disease in the thorax, as in old persons in whom the costo-sternal cartilages are ossified. On the other hand, women generally respire with the chest, from the habit of wearing stays. Habit has considerable influence in this case; and I do not consider the abdominal respiration, in diseases of the chest, so important a sign as it is supposed to be by many; although in many diseases it confirms the diagnosis, it may be absent in others, while the disease is present.

The *unequal respiration*, in which a part of one side of the chest, or the entire side, is inactive, is a sign of greater importance. It occurs in pleurodynia, and in acute hepatitis; pain in the bowels, also, checks the respiration of the corresponding side of the chest. This sign is not easily detected; in order to perceive it, the chest should be laid bare. It is observed particularly in two cases: first, in those cases

of pleuritis in which the ribs, corresponding to the inflamed parts, or the whole of one side of the chest, are immoveable; and, secondly, in tuberculous phthisis. Andral says, "the ribs are immoveable, or do not move so freely in the places where the tubercles are in great number."

In many consumptive persons, we observe that the ribs rise considerably in every inspiration, as is observed in women. In lean persons, we sometimes observe the expansion of the lungs between the cartilages of the upper false ribs. These spaces are extended during inspiration, and collapse during expiration.

From what has been said, it will easily be seen that this mode of exploration is of very little use in general; in private practice, it is almost inadmissible.

## CHAPTER XX.

### SUCCUSSION.

Succussion was first employed by Hippocrates. It consists in shaking the patient's body with some degree of force, and observing the sounds thereby produced. The patient, being seated, is to be shaken by the shoulders briskly, but not violently, the operator suddenly discontinuing the succussion, and observing whether the sound of fluctuation has been produced. In order that any results may be obtained from this method, it is necessary that the liquid, the presence of which we desire to detect in a cavity, should be mixed with air, as in pneumothorax, in large tuberculous cavities in the chest containing a mixture of pus and air, or in cases in which there is a gaseous fluid in the stomach and intestines. The last of these might lead to an error, which may, however, be avoided

by placing the ear upon the abdomen as well as upon the thorax.

Laënnec approved of this mode of exploration, and he relates instances in which he derived much advantage from it. He does not think it, when properly executed, so distressing to the patient as it appears to be.

It would be proper to mention in this place Bichat's unfortunate invention of the *pressio abdominalis*, if it were not happily out of use.

## CHAPTER XXI.

### PALPATION OF THE THORAX.

A waving motion is said to be observed in the intercostal spaces in pericarditis, and in cases of effusion into the pleura. This is denied by Laënnec, who observes that the fluctuation in the intercostal spaces can only take place when the effused fluid has made its way through the intercostal muscles, and has formed an abscess in the external cellular texture; or in cases in which the intercostal spaces protrude in a globular shape, owing to the presence of fluid in the chest.

Tarral has proposed a method of producing fluctuation in the chest in cases of effusion into the pleura :—" one of the fingers is placed between two ribs, at a small distance from which percussion is performed with one of the fingers

of the other hand, and fluctuation is then very distinctly felt, particularly in lean persons." This method is of very little importance, as we are in possession of better and more convenient signs whereby to recognize pleuritic effusions.

The method of *placing the hand upon the thorax* is frequently employed. We know that when a healthy person speaks or sings, the walls of the chest vibrate, and that this vibration may be felt with the hand. The vibration ceases, however, when, in consequence of disease, the lungs are impermeable to air, and when an effused fluid separates the lungs from the walls of the chest. This sign is also of no importance, the vibrations being absent in many persons.

We *feel*, however, a kind of rattle (the case of effusion into the pleura excepted) in cases of tuberculous excavations superficially situated, in catarrhus suffocativus, and in the agonies of death. Laënnec observed it in peripneumonia, in abscess, and in cases in which softened tuberculous matter has been effused into the pleura, the laminæ of which, surrounding the

lungs and ribs, adhere together in their whole extent. He also *felt* a dry crepitation in cases of emphysema of the lungs, particularly in interlobular emphysema. As this method contributes to the certainty of the diagnosis in many cases, it ought not to be neglected.

## CHAPTER XXII.

### MENSURATION OF THE THORAX.

This method is frequently practised by Chomel. He uses the same kind of measure as that employed by tailors, and graduated by inches and lines; with this he measures the transverse diameter of the chest. The patient is seated, with his hands clasped together over his head. The end of the measure is then placed on the middle of the sternum, and the measure is carried to the opposite side of the spine to the spinal process. In the male, it is carried over the papilla; in the female, beneath the breast. He then proceeds to the other side, and acts precisely in the same manner. The patient must be kept as quiet as possible during the examination. For the measurement of the diameter from the front to the back,

Chomel uses an instrument of his own contrivance, resembling a beam-compass.

This method of examination requires considerable accuracy; and, when thus executed, it sometimes yields valuable results. The difference, however, of half an inch or less between both sides of the chest can be observed by the sight; the mensuration should therefore be limited to *less* than half an inch.

END OF PART ONE.

# PART TWO.

## CHAPTER I.

### DISEASES OF THE ORGANS OF RESPIRATION.

#### PLEURITIS.

*Anatomical remarks.*—In a moderate degree of inflammation, the pleura is generally extremely red, the extent of the redness varying according as the vessels which pass through the cellular texture beneath this serous membrane are more or less injected; the membrane itself is, however, transparent, and presents no ramifications of red vessels on its surface. When the inflammation is severe, injected vessels become visible on the membrane itself; but when these are not very numerous, spaces are observed between them, and the membrane remains transparent. The pleura is, in general, not thickened by inflammation.

The *secretion* of the pleura is altered in

quantity and quality. It appears that the exhalation increases with the progress of inflammation, from several ounces to several pounds. In such cases, the lungs are pressed out of their proper position, and the diaphragm forced downwards; in consequence of which, the liver and spleen project, the ribs separate from each other, the intercostal spaces become larger and no longer present the appearance of grooves. In cases of considerable effusion into the left pleura, the heart is sometimes pushed entirely to the right side, and its beats can only be felt behind the sternum, or in the right half of the chest. The fluid secreted by the inflamed pleura consists of albuminous, serous, and sometimes purulent matter: the first of these is converted into false membranes, which are thicker and more extensive in proportion to the more inflammatory nature of the disease. In weak and lymphatic persons, a considerable quantity of fluid and these false membranes are found after an attack of pleurisy. This fluid sometimes changes into pus, and generally contains clots of albumen, coagulated blood, and other substances.

The pleura is frequently covered with growths, which often extend from one surface to the other, forming adhesions between the pleura costalis and pulmonalis. These growths sometimes form cells, which contain the above-mentioned fluid. The adhesions assume the form of *true cellular texture*, which unites both the laminæ of the pleura. In very rare cases, an effusion of fluid into the pleura has been present without any preceding inflammation and without any impediment to the circulation. The false membranes sometimes become fibrous, cartilaginous, or bony substances. But the formation of tubercles in them is of the most frequent occurrence.

These phenomena may take place in one pleura, or in both. The inflammation may be in one part of the pleura, and the effusion may be enclosed by a false membrane; hence the *pleuritis partialis*, *circumscripta*, *diffusa*, *&c.*

The knowledge of the alteration of the position and texture of the lungs in the part where the effusion has taken place is of great importance. The fluid generally presses the lungs towards the spine. In considerable exu-

dations, we sometimes find the lung no thicker than a plate; and, if covered with false membranes, it is in many cases not easily detected. In other cases, only one lobe is pressed by the fluid; and in some instances it is pressed towards the ribs.

*Physical signs of pleuritis.*—The physical signs of pleuritis are those obtained by percussion, those by auscultation, and those by mensuration and palpation.

1. *Signs of Percussion.*—The patient should be seated, and recline backwards, lest the fluid should gravitate downwards; thus we find, even at the commencement of pleuritis, lower down on the ribs near the spine, less tone on the morbid than on the healthy side. In the commencement of an effusion into the pleura, the resonance of the chest decreases on the side in which the effusion has taken place. The dulness of sound in pleuritis generally increases from above downwards; whilst, in pneumonia, the reverse frequently takes place. After the patient has been thus examined, and the different sounds of percussion ascertained, he should be placed on the abdomen and again examined;

and if an effusion be present, elasticity and resonance are found in the parts in which dulness was found before, and vice versâ. In cases of considerable exudations and of hydrothorax, the patient may recline to either side whilst examined. The results of percussion may be modified by various circumstances : the effusion may, for instance, be circumscribed, and no alteration occur in the situation of the fluid, in whatever position the patient be placed. Although we find the dull sound in this case, still it might be the result of pneumonia, or of a tumor in the thorax, as well as of pleuritis; for there is no respiratory murmur in any of these affections. Sometimes an effusion fills up one half of the chest entirely, and the lung adheres to one part of the chest ; in this case, also, alteration of the patient's position does not alter the results of percussion. The same thing occurs when the whole of the pleura is filled with fluid. Effused blood does not alter its position so readily as serous fluids. There are other cases of circumscribed pleuritis in which the resonance of the chest is not at all

obscured, as in pleuritis interlobularis, diaphragmatica, &c.

2. *Signs of auscultation.*—In the commencement of pleuritis, the respiratory murmur becomes feeble on the morbid side, which is not so active as the healthy side. It decreases in intensity as the effusion proceeds, until at length it disappears altogether, excepting along the vertebral column, where it is feebler than on the opposite side. The cases in which the respiratory murmur disappears entirely, are those of very considerable effusion. The more the murmur decreases on the morbid side, the more it increases on the healthy side; it sometimes becomes puerile. The *cause* of the respiratory murmur being heard along the spine and at the posterior part of the thorax, whilst it has ceased on the anterior part, is, that the lungs are generally pressed backwards towards the spine and ribs. In many cases they are pressed upwards, and then the respiratory murmur decreases from above downwards. Sometimes the lower lobe of the lung is kept in its proper place by adhesions; in con-

sequence of which the fluid can only occupy the place of the upper lobe, from which alone the respiratory murmur is then absent. When the respiratory murmur is entirely absent, we sometimes hear, instead of it, the *bronchial respiration*; in some cases, there is no sound whatever.

On applying the stethoscope along the posterior border of the scapula towards its inferior angle, and desiring the patient to speak, his voice is found to resemble the bleating of a goat, and is hence called *ægophony*. This is considered one of the most characteristic signs of pleuritic effusion; but it is not so certain a sign as it is frequently supposed to be; for it is also heard in the second stage of pneumonia, accompanied by the bronchial respiration. Reynaud says that "ægophony is only audible in cases in which the inflammation of the pleura is accompanied by inflammation of the lungs." Whether this be true or not, I do not know. But I know that the resonance of the voice in hepatisation of the lung is frequently like that heard in effusion into the pleura; this is sufficient to disprove the assertion that

ægophony is a characteristic sign of pleuritic exudation. There are other arguments of this kind, which have been noticed before, and which will be mentioned hereafter.

The different gradations of ægophony appear during the increase of the exudation; these are sometimes interrupted; at other times they are only audible by pronouncing certain words. To ascertain the presence or absence of this phenomenon, we ought to examine both sides of the chest comparatively. When the effusion becomes considerable, the ægophony is no longer heard. There are, however, cases on record in which the whole of one side of the chest has been filled with fluid, and ægophony was still present; in others, of no considerable effusion, it has been absent. In the former cases, the lungs have been extremely compressed, and the air unable to pass beyond the bronchi: the bronchial respiration and ægophony are probably owing to the vibration occurring in them. In the latter case, the lung is not much compressed, and ægophony may be produced by the transmission of the voice through a fluid.

When ægophony is present, the sound on percussion dull, and the respiratory murmur weaker than on the healthy side, without audible crepitation, we infer that there is pleuritis. But when ægophony is present, and there is a dull sound on percussion, and the respiratory murmur is altogether absent, or replaced by the bronchial respiration, we cannot say whether the affection be pleuritis or pneumonia.

The sound of *friction of ascent and descent* is considered by many a sign of the dry pleuritis, in which the surfaces of the pleura are rough and uneven. When we wish to hear it, the patient must be placed on the abdomen.

3. *Signs of mensuration and palpation.*— The comparative mensuration of both sides of the chest is frequently useful, both in acute and in chronic pleuritis. In many cases of pleuritic effusion the morbid side is enlarged; in others, no enlargement takes place, owing to the yielding of the diaphragm. When the effusion is not considerable, the fluid occupies part of the spaces allotted to the lungs. In considerable effusions, the intercostal spaces become enlarged and elevated. Reynaud considers the

absence of the vibrations on one side of the chest, which are produced whilst speaking, a certain sign of pleuritic effusion.

From what has been said, it is evident that the physical signs in pleuritis are of the utmost importance, particularly in the chronic form. For all the constitutional symptoms, accompanying chronic pleuritis, occur in many other diseases, and the practitioner may easily be deceived by them, particularly when there is no pain in the side, and no fever. In such cases, we frequently find patients complaining of being unwell, but still continuing to follow their usual pursuits. They generally complain of cold feet or hands, whilst some other limb or part of the body is unusually hot; their features become visibly altered; they become emaciated; the pulse becomes accelerated on the least excitement; the breathing becomes very difficult on using exercise; there is loss of appetite, accompanied with impaired digestion, and febrile paroxysms in the night. But all these symptoms occur also in hectic patients. The diagnosis of pleuritis is, however, soon determined by the dull tone on percussion;

by the absence of the respiratory murmur, and of the resonance of the voice, which is only audible near the spine; by the dilatation of one side of the chest; and by other symptoms.

*Pleuritis diaphragmatica* is generally recognized by the following symptoms. Pain along the cartilaginous margins of the false ribs, immobility of the diaphragm during inspiration, alteration of the features, oppression, and orthopnœa. The forms of pleuritis termed *interlobularis*, *mediastina*, *costo-pulmonalis*, &c. are not easily recognized, at least not by physical signs; the interruption of the functions may contribute to their diagnosis.

Pleurodynia much resembles acute pleuritis. The sound on percussion, in pleurodynia, is frequently dull, and the respiratory murmur weak; both are symptoms of pleuritis. But the respiratory murmur is never entirely absent, since we find it in pleuritis with a considerable effusion; the alteration of the position of the patient has no influence on the sound of percussion; neither ægophony nor bronchophony is heard.

Pleuritis may also be mistaken for acute pneumonia. The sound on percussion, however, in pleuritis, is dull as soon as the effusion takes place; whilst in pneumonia the dulness comes on gradually: there is also, in the latter, no crepitation; ægophony is seldom heard in pneumonia; bronchophony occurs generally.

Pleuritis may *terminate* in *resolution*, in *chronic pleuritis*, or by *death*; the last of these may be produced by asphyxia. Resolution may be either *complete* or *incomplete*. In the former case, the morbid products are all absorbed, and no trace of disease remains, except adhesions. When the resolution is incomplete, the fluid only is absorbed, the false membranes constituting a layer between the pleura costalis and pulmonalis; the sound on percussion, on the morbid side, remains dull for life, and there is contraction of one side of the chest.

The *chronic* form of pleuritis terminates either by recovery or by death. The termination by recovery is effected either by absorption of the effused fluid, which is recognized by the reappearance of the respiratory murmur and a clearer sound on percussion; or the fluid

is evacuated either through the bronchi or through a spontaneous or artificial opening of the thorax. Death may ensue even when the fluid has been evacuated externally, sometimes in consequence of the chronic pleuritis passing again into the acute form, &c.

## CHAPTER II.

### BRONCHITIS.

*Anatomical remarks on acute bronchitis.*—The bronchi are red, sometimes thickened. Some fluid is found in the bronchi, similar to that which is expectorated. Bronchitis generally attacks a part of the lung; the affected parts are frequently of a considerable consistence, but sometimes soft, particularly in bronchitis attended with much fever. The secretion of the mucous membrane of the bronchi becomes altered. At the onset of the disease there is little or no secretion. Sometimes the affection is checked in its progress, and is then called by Laënnec the *dry catarrh.* When the disease proceeds further, the secretion increases, becomes thin, clear, transparent, and of a glairy mucosity, resembling in some degree the white of egg, and acquires a saline and

acrid flavour. When, in this stage, it assumes the chronic form, which is accompanied by increased watery secretion, Laënnec calls it *pituitous catarrh.* As the affection tends to resolution, the sputa change their appearance, the mucosity gradually loses its transparency, it becomes consistent and tough, and is mixed with opaque, yellow, whitish or greenish masses, which are at first scanty, but increase gradually, and ultimately constitute the whole of the matter expectorated, which at the same time obstructs the bronchi and causes the ingress and egress of the air to produce a rattle. The respiration is interrupted in the ramifications of the bronchi, and is only restored by coughing or expectoration, by which the mucus is expelled from the tubes. If the disease proceed, the expectoration increases both in consistence and quantity; the affection becomes chronic, and is then called by Laënnec *mucous catarrh.* The *chronic* form of bronchitis cannot be distinguished from the acute, in the post-mortem examination.

*Physical signs.*—The resonance of the chest is normal; the respiratory murmur is ac-

companied by different sounds which frequently obscure it, or take its place. These sounds are the *sonorous rhonchus* and the *sibilous rhonchus.* When the secretion of the inflamed mucous membrane is established, a *bubbling sound* is heard, occasioned by the passage of the air in the bronchi; this is called the *mucous rhonchus.* When the sonorous rhonchus occurs in a branch of the bronchi superficially situated, and we place the hand on the part of the thorax corresponding to it, we frequently feel a vibration which must not be mistaken for the cat's purr in diseases of the heart. The sonorous rattle is sometimes extremely strong and like the *cooing of a pigeon.* In such cases, we generally find the mucous membrane red and tumid, in the bifurcation of a principal branch of the bronchi. When the rattles are heard over the whole extent of one or both lungs, the case is alarming; if the affection is at the same time acute, the symptoms are severe; if chronic, we find great feebleness, dyspnœa, &c. which are the more severe in proportion to the advanced age of the patient. The rhonchus in bronchitis is always limited to the affected part; the more exten-

sively it is heard, the more extensive is the disease and the greater the degree of the affection.

It sometimes happens that the respiratory murmur is no longer heard over a considerable extent of the lung. This is occasioned by mucus obstructing some large bronchus, and preventing the ingress of the air: after the removal of this by expectoration, the respiratory murmur reappears. The absence of the respiratory murmur, as above mentioned, must not be mistaken for a symptom of hepatization of the lung; since the sound on percussion will be found to be clear.

## CHAPTER III.

### PNEUMONIA.

*Anatomical remarks.*—In *acute* pneumonia, the inflamed parenchyma of the lung may undergo, according to Laënnec and Andral, three changes, which are termed by the former of these writers—

1. *Engorgement of blood* (engouement);
2. *Hepatization;* and
3. *Purulent infiltration.*

Andral distinguishes these changes into the *red* and the *grey softening* (ramolissement). Induration (endurcissement) only occurs in *chronic* pneumonia, and is either red or grey.

*Engorgement, the first stage.*—In the commencement of the disease, the lung is less lubricated and elastic; crepitation is produced by pressure; frothy blood, mingled with serum, is poured forth from incisions; the parenchyma

assumes an increased redness, and does not tear by pressure and pulling. As the disease advances, pressure produces crepitation similar to that of the lungs of the fœtus which has never respired; the red colour becomes brown; the consistence diminishes so much that the parenchymatous substance tears as readily as the spleen, which it also resembles in other respects. Hence, this stage is also called that of *splenization.*

*Hepatization, the second stage* (ramolissement rouge, Andral).—The lung presents in this stage the greatest similarity to the liver, when saturated with blood. It is of a red colour; pressure no longer produces crepitation; the lung sinks in water. On looking with a magnifying glass at the cut surface, numerous red granulations are observed; the slightest touch tears the parenchyma; a little fluid like dregs exudes on pressure; the volume is apparently increased.

*Purulent infiltration, the third stage* (ramolissement gris, Andral).—The parenchyma is firm, compact, and impermeable to air; and hence there is no crepitation. A slighter touch than in the second stage tears the paren-

chyma, and the surface of the torn part presents the same appearance as that in the second stage. The colour, however, is of a whitish grey ; whilst in the second stage it is red. The lung contains a fluid resembling pus, which is mingled here and there with blood.

*Chronic* pneumonia may be a primary affection, or the sequela of acute pneumonia. The organic alterations in chronic pneumonia are the same as in the acute form. The former is, however, characterized by the *dry* and *hard* state of the parenchyma ; whilst, in the latter, it is soft and filled with fluid ; its colour is generally grey, but sometimes it retains its light red colour ; and consequently we have here a *red* and a *grey induration* (induration rouge et grise), as we had before a red and a grey ramolissement. Andral considers melanosis of the lung to be induration of its parenchyma ; hence, another variety might be added, termed *black induration.*

*Physical signs.*—The sound on *percussion* in the earliest stage is not altered, but the resonance soon decreases. In the second and third stages, the dull sound in the affected

part is evident, excepting in lobular pneumonia, and in cases in which the disease has its seat in the centre or root of the lung.

The signs on *auscultation* are the following: in the *first stage*, the respiratory murmur is feeble over the affected part, sometimes scarcely perceptible; or it is masked by the *crepitous rhonchus*, the respiration being frequently puerile in the sound parts. So long as the respiratory murmur is audible, the inflammation is not far advanced; but, if the respiratory murmur be entirely masked by the crepitous rhonchus, it is far advanced, and tends to the second stage. If in the course of the disease the crepitous rhonchus cease, the respiratory murmur reappears in proportion as the former declines; or the respiratory murmur does not return at all. In this case, there is either no sound, or one of an entirely different kind, of which we shall speak hereafter. In the *second stage*, the crepitous rhonchus and the respiratory murmur are no longer heard, the cells of the lungs being no longer permeable to air; the respiration becomes hurried, or we perceive the *bronchial respiration*, which some-

times becomes *tubular*, and frequently presents the sound termed, by Bouillaud, *broncho-ægophony*. In some cases, the respiration is perfectly natural, but much more intensive over the diseased than over the healthy side; percussion will enable us to avoid errors in this stage of the disease. The bronchial voice is most audible at the inner edge and lower angle of the scapula and fossæ supra, and infraspinosa. In the *third stage*, the sound on percussion is dull; there are bronchial respiration and bronchial voice; there is no respiratory murmur. Should resolution now take place, the disease will be found to retrace its steps precisely in the same manner in which it proceeded. If the disease advance, the *mucous rhonchus* becomes audible. If an abscess form, we perceive a *guggling*, or *cavernous rhonchus*; when the contents of the abscess have been evacuated, *cavernous respiration* and *pectoriloquy* are perceptible. If the cavity be large, the *metallic tinkling* may manifest itself.

*Gangrene* will be indicated by the fœtor of the breath, and expectoration.

## CHAPTER IV.

### TUBERCULOUS PHTHISIS.

*Anatomical remarks.*—Tubercles are found in the parenchyma of the lung. They are generally of a globular form, varying in size from that of a millet seed to that of an apple; their consistence is that of firm cheese; they are very friable, and are neither transparent nor organized. These tubercles terminate in pus, which passes through the bronchi; hence, instead of tubercles, we find excavations, which are either isolated, or communicate with each other. In proportion as the tubercles are in greater number, and increase in size, the more they encroach upon the surrounding texture; the cells become compressed, the blood vessels are reduced in size and become obliterated, and the blood does not circulate freely. These

excavations are sometimes perfectly empty; but they generally contain a whitish, yellow, or grey fluid, containing small masses. The parenchyma, surrounding the excavations, is always condensed and impermeable to air. In some rare cases, the excavations heal, and a cicatrix is formed by false membrane. Instead of the transformation of the tubercles into pus, they sometimes become indurated, and are of a chalky, bony, or even stony consistence. These concretions appear to be nothing but tuberculous matter, deprived of its fluid and animal substances by means of absorption, in consequence of which phthisis is sometimes cured. The tuberculous matter sometimes infiltrates into the lung. This infiltration is sometimes grey, sometimes gelatinous; the latter is either red or colourless. The parts surrounding the tubercles are sometimes inflamed; the parenchyma is then hard, red, and very friable. Sometimes the parenchyma is emphysematous. In other cases, we find the bronchi, larynx, or trachea thickened, or their mucous membrane ulcerated.

*Physical signs.*—In the *first stage*, viz. that

before the formation of excavations, the *sound on percussion is dull, and there is no respiratory murmur*. The *cause* of this is the presence of the tuberculous matter, or induration of the parenchyma of the lung surrounding the tubercles. These two signs occur also in chronic pneumonia with hepatization, and in pleuritis with effusion. When they are found, however, at the upper part of the lungs beneath the clavicles, whilst the tone over all the other parts of the chest is normal, and the lungs permeable to air, they denote the presence of tubercles, being principally met with at the upper part, whereas pneumonia usually attacks the lower part of the lungs.

A dry cough, limpid sputa, pain at the lateral parts of the chest or at the back, hæmoptysis, a dull sound beneath the clavicles, diminished respiratory murmur, the mucous and sonorous rattles at the upper part of the chest, whilst the other part is in a natural condition, denotes the presence of crude tubercles. The above-mentioned symptoms are frequently accompanied with considerable languor; slight

exertions or walking up stairs cause a hurried breathing, and increase the frequency of the pulse.

The two physical signs above mentioned may frequently be absent, even when phthisis is present. When the tubercles are dispersed, and small, the texture of the lungs around them generally remains permeable, the resonance is unaltered, and the respiratory murmur is equally audible over the whole extent of the chest.

In the *second stage*, we find excavations in the lungs, the presence of which is corroborated by the *cavernous respiration*, the *gurgling rattle*, the *cavernous voice*, *great resonance*, or the *entire absence of tone*, and the *metallic tinkling*. The cavernous respiration is also heard in considerable dilatation of the bronchi; the gurgling rattle in pneumonia, and chronic catarrhs; the cavernous voice is with difficulty distinguished from bronchophony; absence of sound is also a symptom of many other diseases of the chest; the increased resonance of the chest occurs also in emphysema of the lungs,

and in pneumothorax; and the metallic tinkling is very rare. Hence, it is necessary to bear in mind that the disease principally affects the upper part of the lung, in which part we generally find tubercles, grey substance, and excavations; and hence the dull resonance on percussion at the upper part, whilst the rest of the chest presents its usual sound. This fact is frequently sufficient to enable us to recognize phthisis, especially when combined with great emaciation and long duration of the disease. When the sputa become thicker and tinged with yellow striæ, the respiration beneath the clavicles becomes strong and tracheal, which is particularly the case in those places in which, after death, the largest excavations are found. In addition to this, we frequently find the crepitous or gurgling rattle; sometimes resonance of the voice, or the cavernous voice. The part to which this variety of signs is limited is small, but it increases daily. These different rattles are plainer as we auscultate nearer to the clavicle, and become more indistinct the further we auscultate from this part;

particular attention should be paid to this circumstance, inasmuch as the gurgling rattle, the cavernous voice, and respiration, are sometimes present without excavations; this is, however, of extremely rare occurrence.

# CHAPTER V.

## DISEASES OF THE HEART.

### PERICARDITIS.

PERICARDITIS, or inflammation of the pericardium, may be *acute* or *chronic*. In the former, we find inflammatory congestion, and secretion of false membranes, or of pus. In the latter, we observe a defined organization of false membranes and their different transformations.

*Physical signs.*—The beats of the heart are stronger and more frequent than in the normal condition, sometimes regular, sometimes irregular, unequal, intermittent, with palpitations. The impulse of the heart is sometimes seen, and frequently felt, in the præcordial region, which projects forwards; the sound *on percussion* is dull, and its diffusion directly proportionate to the quantity of the effused fluid and the inflammatory swelling of the heart. The dulness of sound is sometimes observed in the lower part,

sometimes higher up in the anterior part, of the left side of the chest. This phenomenon occurs in the dry pericarditis, in which there is little secretion, and in which there is severe inflammatory swelling of the heart. The dull sound is only present when the exudation is considerable. The sounds on *auscultation* are the *bruit de frottement*, *de souffle*, *de scie*, *de rape*, and *de cuir neuf*; and I have also observed in several cases of pericarditis the *purring sound*. The pain in the region of the heart, which has always been considered a constant symptom of pericarditis, is of rare occurrence.

## CHAPTER VI.

### HYPERTROPHY OF THE MUSCULAR SUBSTANCE OF THE HEART.

THERE are three different forms of hypertrophy :—*simple hypertrophy*, *hypertrophy with dilatation*, *and hypertrophy with contraction*.—The first of these consists simply in a thickening of the walls, the capacity of the cavities of the heart continuing to be normal. In the second variety, the walls are not always thickened. They may retain their usual thickness, and yet be hypertrophied, the increase being proportioned to the increase of the capacity of the cavities. Hence we have *hypertrophy with dilatation and thickened walls*, *and hypertrophy with dilatation and without thickened walls*. The third variety consists in a thickening of the walls at the expense of the capacity of the cavities. When dilatation is predominant, it is termed *dilatation with thickening*, and vice versâ. The

most frequent form of the disease is hypertrophy with dilatation.

The dilatation may be so considerable that a body of the size of an orange may be placed in the ventricle; or the ventricle may be so contracted as scarcely to contain a small egg. The weight of the heart in hypertrophy may be three times that of the normal state. Bouillaud has found the maximum weight to be twenty-two ounces, the minimum twelve. The thickness of the walls of the left ventricle varies from seven to fourteen lines; that of the right from three to five lines: Bouillaud has, however, seen the left ventricle of sixteen lines. The circumference is often more than twelve inches; the longitudinal diameter, five inches; the transverse, eight inches. There are cases on record in which the hypertrophied heart occupied the entire half of the chest. In such cases, the heart sinks, the diaphragm yields, and its impulses are then perceptible in the epigastric region. Hope says, "when the heart is considerably enlarged and adheres to the pericardium, it is retained in a higher position, and causes the præcordial region to project." I have

observed this myself in several cases. When the right ventricle alone is hypertrophied, it sinks lower down than the left, and forms the apex of the heart. Hypertrophy of the ventricular septum generally takes place at the expense of the right cavity. In simple hypertrophy, and in hypertrophy with dilatation, the thickness of the walls generally increases from the apex to the base of the heart, as in the normal condition; whilst, in hypertrophy with contraction, the thickness is often equal in all the parts. The substance of the parietes in hypertrophy is generally firmer and more red than in the normal condition; the increase of consistence sometimes reaches the state of induration.

The left ventricle is more liable to hypertrophy than the right, and it is generally connected with dilatation. Sometimes we find the corresponding auricle hypertrophied; it is also generally dilated.

*Physical signs in general.*—In a considerable degree of hypertrophy, we can observe the beats of the heart to a great extent in the left side of the chest, and also towards the region of the stomach. The apex of the heart extends lower

down and more to the left; and raises the sixth, seventh, and frequently the eighth, intercostal space, whilst the motions of the base correspond to the second or third intercostal space.

The *impulse* communicated to the stethoscope is so strong, that it sometimes raises the auscultator's head. The greater the hypertrophy, the longer is the tempo of the contractions of the ventricles. The back-stroke is sometimes very strong, but not so strong as in hypertrophy with dilatation. In hypertrophy with contraction, I have observed it only once.

The beats of the heart in hypertrophy are not more frequent than in the normal condition; they are even slower when the hypertrophy is considerable. During the paroxysm, the beats amount to palpitations, and are consequently then more frequent. The rhythm is not altered, provided the valves are not affected.

The *sounds of the heart* differ with the degree of the hypertrophy. Thick walls do not convey the sound properly; hence, in a considerable degree of thickening, in which the normal capacity of the cavity is lost, the sounds are dull and feeble. When the thickening is

not considerable, and the cavity retains its usual capacity, or is dilated, the sounds are stronger, more sonorous, and clearer, and they are audible to a great extent over the chest, even at the posterior wall. We sometimes hear the *metallic tinkling* during each systole of the ventricles.

The *bellows' sound* is frequently audible during the paroxysms; it is also sometimes audible in hypertrophy with dilatation, in cases in which the valves are not affected.

In simple hypertrophy, the first sound is duller and of longer continuance in proportion to the extent of the hypertrophy; and it generally passes into the second sound without a pause. In a considerable degree of hypertrophy, the first sound is almost entirely absent. The second sound is very short and weak; and in a considerable degree of hypertrophy, it is scarcely perceptible. The pause is shorter than usual, the first sound being longer. All these signs are more marked in hypertrophy with contraction.

I have observed several cases which induce me to contradict Hope's assertion that "the

impulse of the heart, in hypertrophy with dilatation, is of a *jerking* kind, as in the nervous palpitation; whilst, in simple and strong hypertrophy, the ventricle appears to rise in its whole longitudinal diameter towards the chest." During the paroxysms of hypertrophy, the impulse and sounds become frequently weaker and cease altogether. The sound, *on percussion*, in the præcordial region, is dull; the dulness being proportioned to the extent of the heart and the thickness of its walls. The *projection* of the præcordial region is a circumstance of frequent occurrence in hypertrophy, particularly when united with dilatation.

*Signs of hypertrophy of the left ventricle.*— The contractions of the heart, when explored between the cartilages of the fifth and seventh, or even eighth, ribs, yield a stronger impulse and a duller sound than natural; and the præcordial region projects considerably. The pulse is strong, full, vibrating, and expands considerably; the face is flushed, the eyes are bright; occasionally there are giddiness, bleeding from the nose, buzzing in the ears, &c.

*Signs of hypertrophy of the right ventricle.* The impulse of the heart's action is augmented, and felt strongest under the inferior portion of the sternum, where the sound is also dull, but not to the same degree as in hypertrophy of the left ventricle. If the left ventricle be not hypertrophied at the same time, the pulse is not so strong and vibrating; and expectoration of blood and active congestions of the lungs are present. The tumefaction and pulsation of the jugular veins, which are said to be uniformly observed in hypertrophy of the right ventricle, are, according to my observation, not so constant as is generally considered. In several cases in which I have observed it, the right auriculo-ventricular orifices were diseased; and I think they are frequently affected when the jugular veins fluctuate.

## CHAPTER VII.

### DILATATION OF THE CAVITIES OF THE HEART.

DILATATION of the cavities of the heart occurs under three forms; viz. dilatation with *thickening of the walls*, that in which the *walls are natural*, and that accompanied with *thinness of the walls*. The two first of these are analogous to hypertrophy with dilatation, and hypertrophy without alteration of the walls; and the observations made in the last chapter are applicable to these two varieties of dilatation. The one denomination implies that hypertrophy, the other that dilatation, is predominant.

*Signs of dilatation with thinness of the walls.*—Palpitations are of frequent occurrence in dilatation, and are generally more or less accompanied by oppression, a soft, weak, and

small pulse, heavy respiration, cough, and serous expectoration, œdema of the lungs, serous infiltration in the limbs, and increased exhalation of the serous membranes, hydropericarditis, ascites, hydrothorax, extreme pallor, violet or dark red complexion, the presence of lead-coloured rings round the eyes, congestion of the brain, headache, sopor, hæmorrhages, enlargement of the liver, &c. These symptoms also occur in diseases of the valves, and do not, therefore, by themselves, indicate dilatation of the heart; even when combined with the physical signs, they do not always confirm the diagnosis. Laënnec and Hope consider a *permanent turgescence of the external jugular vein*, without perceptible pulsation, to be a most *constant and characteristic sign of dilatation of the right cavity*; the turgescence does not cease when the vein is compressed at the upper part of the neck. The *impulse* is diminished; the first sound is like the second; and sometimes they can only be distinguished by the first sound being synchronous with the arterial pulse.

In thinness of the walls, without dilatation, the

sound of the systole of the ventricles is louder and shorter than in the normal condition. The sounds of the heart are generally heard over a great extent of the chest, which is proportioned to the loudness of the sound. In lean persons, in children, and in persons with narrow chests, the sounds are heard very extensively, even under the right scapula. The sounds of the heart are not always louder in this disease than usual; but, in hypertrophy with dilatation, this is generally the case. The sounds are weak at a short period before death, and in softening of the heart. The sound *on percussion* is dull to a greater extent than usual.

## CHAPTER VIII.

### DISEASES OF THE VALVES OF THE HEART.

*General remarks.*—Diseases of the valves are more common in the left than in the right side of the heart. Diseases of the valves of the right side are generally accompanied by affections of the left. The texture of the valves being sero-fibrous, they are very liable to induration, and particularly to become cartilaginous, and sometimes ossified. The induration of the right valves is generally cartilaginous; that of the left, more of a bony nature. Calcareous indurations and warty excrescences have also been observed in the valves of the heart; these are sometimes dispersed, sometimes grouped like a branch of grapes or the head of a cauliflower; sometimes they extend as high as the auricles, and sometimes appear upon the orifice of the valve.

*Physical signs.*—The application of the hand to the præcordial region enables us sometimes to detect modifications of the heart's rhythm. The intermittent, irregular, and delirious pulse is almost an invariable sign of this affection; the same may be said of the purring sound. With regard to the rhythm, the motion of the heart may be accelerated three or four fold. By means of auscultation, we observe the bellows', saw, and file sounds.

*Contraction of the orifices.*—The observations made by Laënnec upon this disease, in his first edition, are the following:—1. When the bellows', the rasp, and saw sounds are synchronous with the pulse and with the systole of the ventricles, we may conclude that the contraction is that of an arterial orifice. 2. When the same sounds are synchronous with the systole of the auricles, the auriculo-ventricular orifices are affected. 3. The greater intensity of these sounds, in the region of the fifth, sixth, and seventh cartilages of the ribs, indicates contraction of the orifices of the left side of the heart; their greater intensity at the lower part of the sternum indicates contraction of

the orifices of the right side. The isochronism of the different sounds with the systole or diastole of the ventricles is of no value in the diagnosis; for these sounds are frequently audible during the double motion of the heart, and are heard instead of that of the tick-tack. This is plain enough, particularly if we consider that those orifices are constantly open, their valves being unable to close them; and that, in consequence of this, a certain quantity of blood rushes back through the orifices, and thus produces the bellows' sound.

If we desire to recognize in which part of the heart the disease is seated, we must direct our attention particularly to the præcordial region, in which the sounds are heard most distinctly. The arterial orifice on the left side being, however, situated close to the corresponding auriculo-ventricular orifice, it cannot always be decided which of the orifices is affected. When the orifices of the left side are contracted, the pulse is irregular, small, and intermittent; but more so in affection of the orifice of the aorta than in that of the auriculo-ventricular orifice. When the orifice of the aorta is

affected, the vibratory thrill is also observed. We also feel the purring sound with the greatest intensity at the part of the præcordial region corresponding to the contracted orifice.

Contraction of the right orifices is generally recognized by the purring vibration being felt with its greatest intensity over the parts corresponding to the right orifices, and by the pulsations of the jugular veins. When the valves are hypertrophied, the sounds of the heart increase considerably, and produce, generally, the bruit de parchemin.

THE END.

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